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This report is a study of the operation of psychological processes in children in school, and of the application of knowledge about psychological processes to pupil personnel work. Investigated are three kinds of processes: perceptual, intellectual, and affective. The first seven chapters of the report present theoretical models, literature surveys, and research studies relevant to the study of perceptual and intellectual processes. Chapters eight and nine deal with affect processes; more specifically, with school anxiety. Chapter 10 presents a model for integrating research on psychological processes with pupil personnel work. (AUTHOR)

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PSYCHOLOGICAL PROCESSES
AND
PUPIL PERSONNEL SERVICES

Project No. MH 14763-06

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1968

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INTRODUCTION

This report is a study of the operation of psychological processes in children in school, and of the application of knowledge about psychological processes to pupil personnel work. Three kinds of processes: perceptual, intellectual, and affective, are investigated.

The first seven chapters of the report present theoretical models, literature surveys, and research studies relevant to the study of perceptual and intellectual processes. Chapters eight and nine deal with affective processes; more specifically, with school anxiety. Chapter ten presents a model for integrating research on psychological processes with pupil personnel work.

Basic Assumptions

The material presented here and in reports of the Midwest Regional IRCOPPS Center is based on the view that individual variations in the efficiency of functioning of psychological processes influence performance in school and that an individual's capacity to use psychological processes effectively varies with the situation in which he finds himself.

The first of these assumptions raises four questions which may be used to direct research.

Are there relationships between specific psychological processes and academic task performance?

What is the form of the relationship between process and performance? Typically the assumption is that the relationship is linear. However, this is not always the case. The relationship between anxiety and achievement, for instance, is thought to describe a U-shaped function.

Can individuals be taught to increase the efficiency of functioning of psychological processes?

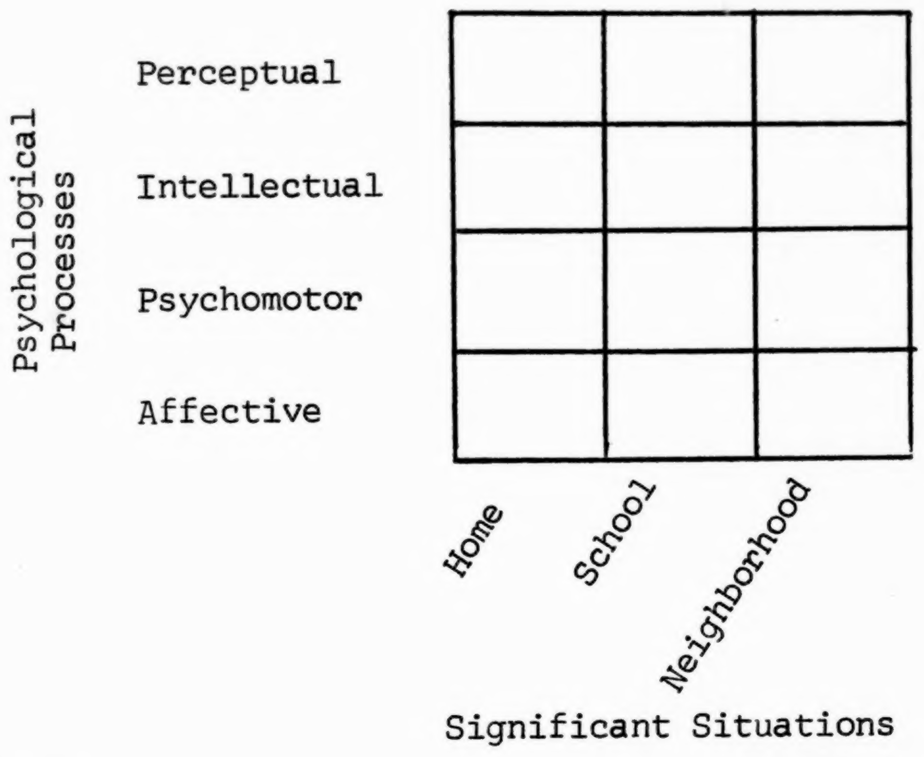
Will a change in process efficiency result in a change in academic performance?

The assumption that the efficiency of functioning of psychological processes varies with changes in situation suggests the need for defining psychological processes in terms of the situations in which they are used. The history of psychology is replete with unsuccessful attempts to establish general theories capable of predicting behavior in all situations. In recent years, there has been some movement toward replacing such attempts with what might be called a psychology of significant situations, a psychology with operational definitions and predictions of behavior limited to important life situations.

In a child's life, the home, the school, and the neighborhood can be described as significant situations. The research efforts in this report focus on the definition of psychological processes in terms of school situations.

Figure 1 presents a diagram relating psychological processes to significant situations.

Figure 1



As mentioned above, research described in this report includes studies relevant to the functioning of perceptual, intellectual, and affective processes in the school. The focus, however, is mainly on perceptual processes. Reports from the Midwest Regional IRCOPPS Center have provided detailed consideration of intellectual and affective processes.

CHAPTER I

THE STRUCTURE OF PERCEPTION[1]

John R. Bergan

The structure of perception model is a classification system for determining possible definitions of perception and for applying them to educational problems. It hypothesizes separate abilities for each of the definitions which it produces. The model is built on the assumption that four variables define perception: the stimulus characteristic observed, the perceptual task of the observer, the content categories of the stimulus observed, and the sense modality through which the observation occurs.

Variables Defining Perception

Stimulus Characteristics. Stimulus characteristics, as the concept is used in this report, are the characteristics of external stimuli as perceived by an observer. Although stimulus characteristics are external to the perceiver, it is assumed that he plays a major role in defining them. The functioning of the perceptual apparatus involves the imposition of structure on incoming information. The order thus imposed in part defines stimulus characteristics. The stimulus characteristic, form, for example, is defined in part by perceptual functioning. Words like circle, square, triangle, etc., describe objects as they are perceived. The same objects could be described in terms of molecular arrangement or in any number of other ways.

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[1] The material in this chapter is taken from the final report for Office of Education Project No. 5-0583-2-12-1, *A Study of the Relationships Between Perception and Reading*. It is included here because it provides a framework which greatly influenced the design of the perceptual studies presented in subsequent chapters of this report.

Stimulus characteristics are composed of dimensions, i.e. discriminable attributes capable of quantitative variation. When only one dimension describes a stimulus characteristic, that characteristic is a dimension. Size, for example, is a dimension. Position in space, on the other hand, is not a dimension but rather is defined by three dimensions.

Stimulus dimensions may be represented at constant or varying values which can impose limitations on perception. For example, a size limitation could be imposed on visual perception by presenting an object sufficiently small to be difficult to see.

Variations in value, in addition to limiting perception, provide a basis for establishing perceptual thresholds. For example, an investigator might limit pitch discrimination by presenting tones at varying intensities. He also might vary intensity for the purpose of establishing a threshold, e.g. the intensity at which an individual were capable of detecting a sound.

While experimental studies in perception are for the most part concerned with threshold measurement, assessment in education typically involves an effort to produce individual differences in perception by presenting stimulus values which can impose limitations on performance. No effort is made to establish thresholds. It is possible that valuable information is lost by the typical assessment procedure since threshold sensitivity is not necessarily correlated with performance under limitations imposed by stimulus values.

As an example, on a standardized test, even on a power test, the typical procedure is to base the subject's score on the number of correct answers. An alternate approach, analagous to measurement of threshold sensitivity, would be to determine scores on the basis of the point at which the subject began missing all items.

Limitations imposed by constant and varying dimension values play a major role in determining definitions of perception in that limitations on one dimension affect perception of that dimension and/or other dimensions. For example, a size limitation can affect size perception, form perception, position perception, etc. These interdimensional effects produce great complexity in the specification of definitions of perception by opening the way for generating definitions by combining stimulus characteristics. The systematic specification of such combinations will be discussed below.

Perceptual Tasks. A perceptual task is a set of requirements imposed on an observer. Task requirements serve two functions. They provide conditions which enable an observer to report what he has perceived, and to some extent they determine what the observer will perceive. The latter function has not been sufficiently emphasized in the study of perception. Too often the perceptual task is regarded primarily as a means of reporting perception. A specific task is seen as providing one of many possible ways to indicate experience. What is perceived is thought to be determined primarily by the stimulus characteristic being observed.

The lack of consideration of the perceptual task as a determinant of perception does not imply that its importance in defining perception is not known. Psychophysics, for example, specifies elaborate theoretical structures describing the role of various tasks in determining perception (Guilford, 1954). What is known about perceptual tasks, however, is often not considered in the construction of perceptual theory and in the development of techniques for assessing perception.

A perceptual task has three components: the number and arrangement of stimuli, the instructions to the observer, and the behavior required of the observer. Only the last of these serves to indicate what has been perceived, while all three of them play a role in determining what is perceived.

Variations in stimuli affect perception by altering what the perceiver can observe. The stimuli in a scanning task, for example, provide a different set of potential observations than the stimuli in a discrimination task.

Instructions determine what will be perceived in three ways: First, they play a well-known role in manipulating perceptual set or expectancy. Second, they affect attention. Third, they influence perception indirectly by guiding the behavior of the observer as he attends to the stimuli presented.

The control of set and attention effected by instructions, in part, determines the stimulus characteristic or combination of characteristics which will be perceived. The presentation of a stimulus typically involves many characteristics. An observer may be asked to respond to all of these, to some combination of them, to his own selection of characteristics, or to just one characteristic.

The effect of instructions on behavior influences the reaction of the observer to the stimuli presented and his means of indicating what he has perceived. For example, the instructions in a visual discrimination task request the observer to engage in "comparison" behavior and tell him how to report the results of his comparisons.

The behavioral component of a perceptual task serves as the indicator of what has been perceived and determines perception by influencing the manner in which the perceiver makes selections from the stimuli available for observation. The "comparison behavior" in a discrimination task, for example, involves a different stimulus selection procedure and consequently a different set of experiences from the "search behavior" in a scanning task.

Contents. Content categories are culturally-determined classifications based on stimulus characteristics. The characteristic most extensively used in the definition of content categories is form. Some forms are classified as words, others as geometric shapes, etc. There is presumably no inherent basis for the establishment of content categories. A number or word presented visually, for example, is not basically different from a complex geometric design. However, because of cultural factors, people often respond differentially to certain categories of material. For instance, the existence of separate intellectual abilities for various content categories is well-documented (Guilford, 1960; Thurstone, 1944). Goins (1958), among others, has noted content-related differences in perceptual abilities.

Sense Modalities. Sense modalities refer to the types of senses through which information is processed. Each sense modality is responsible for processing a different kind of stimulus information and accordingly provides a different set of perceptual experiences from every other sense modality. Furthermore, there are restrictions on the combinations of sense modalities with the other variables defining perception. That is, it is not always possible to select a stimulus characteristic, content, and response type, and investigate them under different sense modalities. For example, one cannot investigate loudness in the visual mode. Nevertheless, a certain amount of flexibility in combining sense modalities with other variables does exist, in that some stimulus characteristics, contents, and tasks are associated with more than one sense. Size, and texture, for example, are tactual and visual stimulus characteristics. Position in space is a characteristic associated with the visual, kinesthetic, olfactory, auditory, tactual, pain, and pressure senses.

The Classification System

The structure of perception model generates definitions of perception by specifying systematic combinations involving the four variables described above. Some of the definitions describe known measures of perception. Many more specify definitions which have never been the subject of empirical study.

Three types of combinations are used in the model: combinations involving sense modalities, stimulus characteristics, contents and response types; combinations of stimulus characteristics within a given sense modality; and combinations of stimulus characteristics from different sense modalities.

The Model. Type-one combinations generate definitions of perception directly, and thereby specify the structure of perception. For example, the combination of the stimulus characteristic, size, in the visual mode with semantic content, and a discrimination response specifies a definition of perception. Type-two and type-three combinations generate groupings of stimulus characteristics which can be combined with the other variables in the model to produce definitions of perception.

The structure of perception built from type-one combinations is represented diagramatically in Figure 2 by a series of cubes, one for each sense modality. Each cube specifies that within a given sense modality, stimulus characteristic, contents, and perceptual tasks combine to produce definitions of perception. Dots represent structures for sense modalities not shown. (See Figure 2, Page 11).

Intra-modal Combinations. Earlier it was pointed out that stimulus dimension values can impose limitations on perception. Type-two combinations are produced by such limitations. Stimulus dimension limitations make it possible to combine each stimulus characteristic within a given sense modality with every other stimulus characteristic in that modality. Furthermore, any number of stimulus characteristics can be combined simultaneously.

An example of type-two combinations involving three visual stimulus characteristics is given in Figure 3, Page 12. The 12 combinations generated from only three characteristics illustrate the great complexity which type-two combinations produce in the definition of perception.

Inter-modal Combinations. The third type of combination specified by the structure of perception model involves stimuli from different sense modalities. It is possible to study a particular perceptual ability involving one sense modality under limitations imposed by stimuli from other sense modalities. Figure 4 indicates possible definitions of perception produced by combining a single visual stimulus characteristic, position in space, with stimuli from the auditory and kinesthetic modalities (See Figure 4, Page 13).

Model Definitions As Constructs

The definitions of perception produced by the structure of perception model represent constructs which lie somewhere between theoretical constructs and operational definitions. The definitions generated by the model are descriptive of operational definitions of perception. In contrast to the hypothetical constructs used in perceptual theory, they are not intended to infer abilities or characteristics of the perceptual

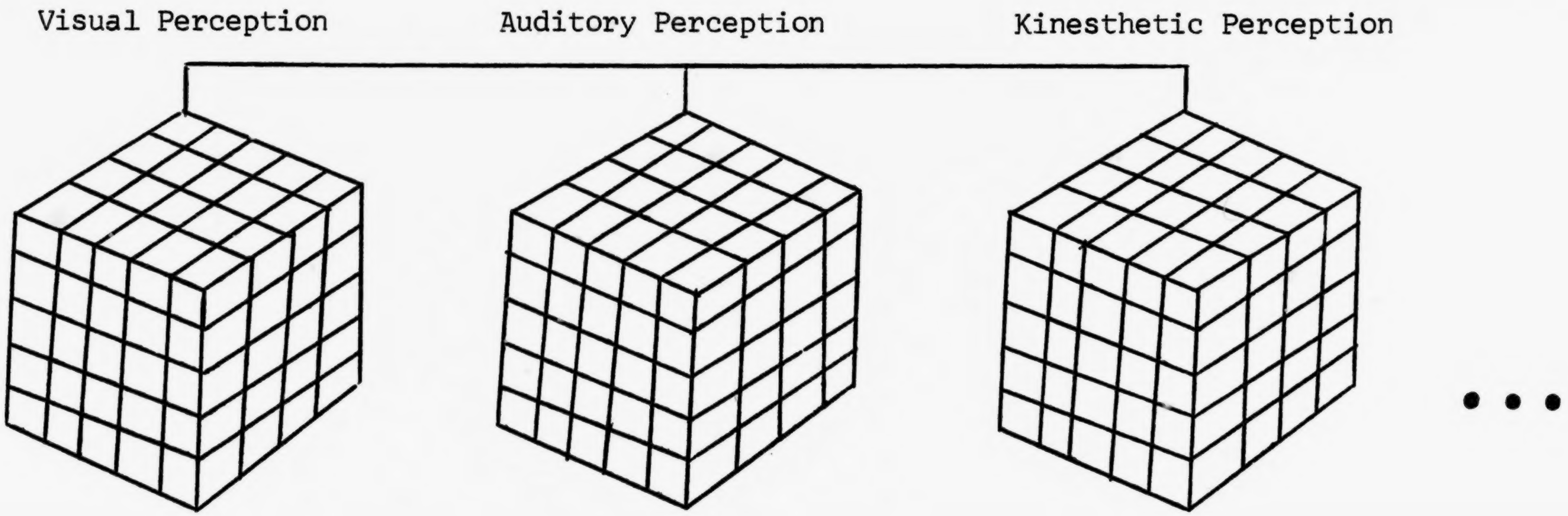

Figure 2

The Structure of Perception

Dots represent additional structures for other sense modalities. Cells represent combinations of stimulus characteristics, tasks, and contents. Lines connecting the cubes indicate definitions of perception based on inter-modal combinations.

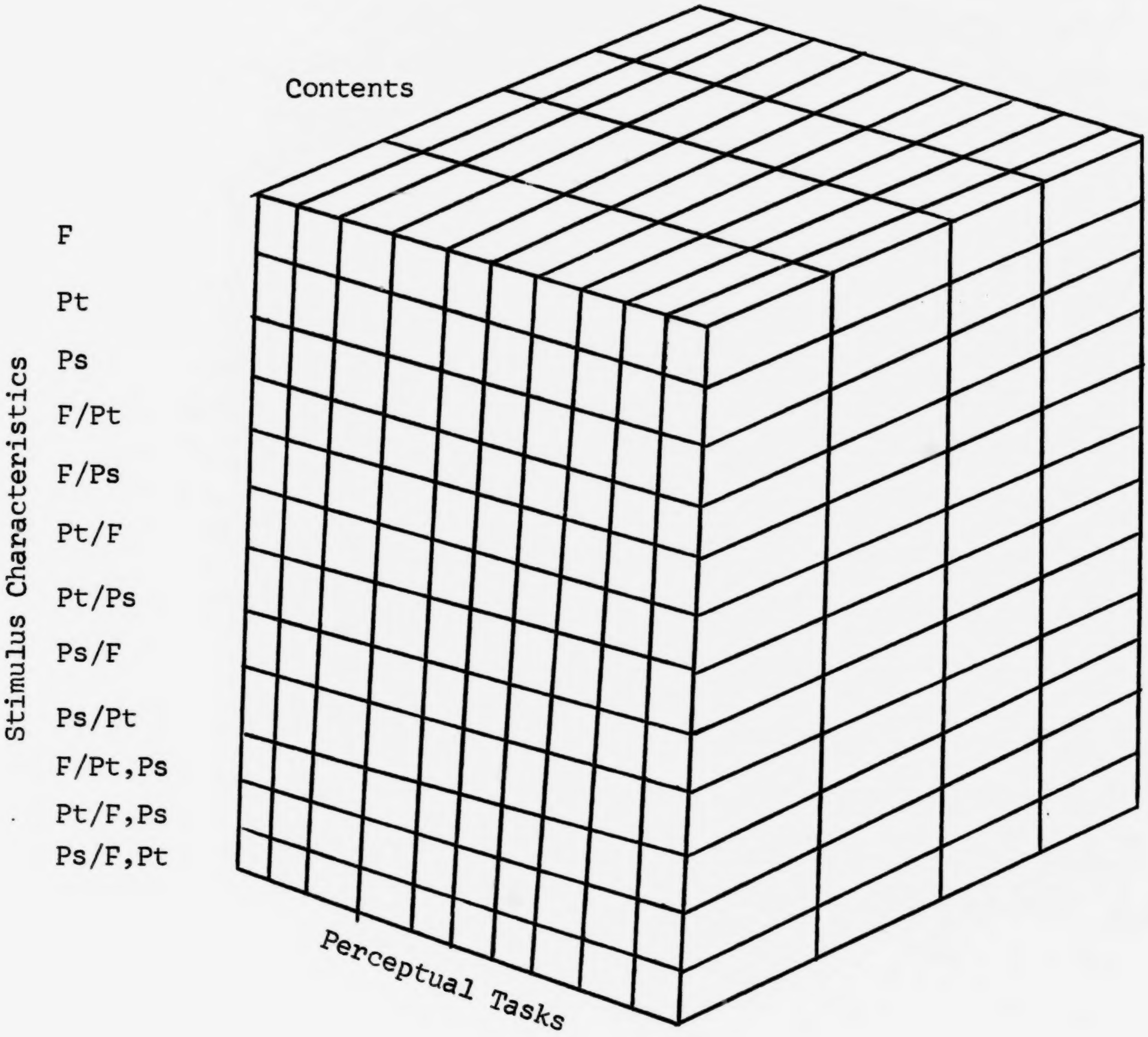

Figure 3

Intra-Modal Stimulus Characteristic Combinations

F=form, Ps=position in space, Pt=position in time, /=limited by

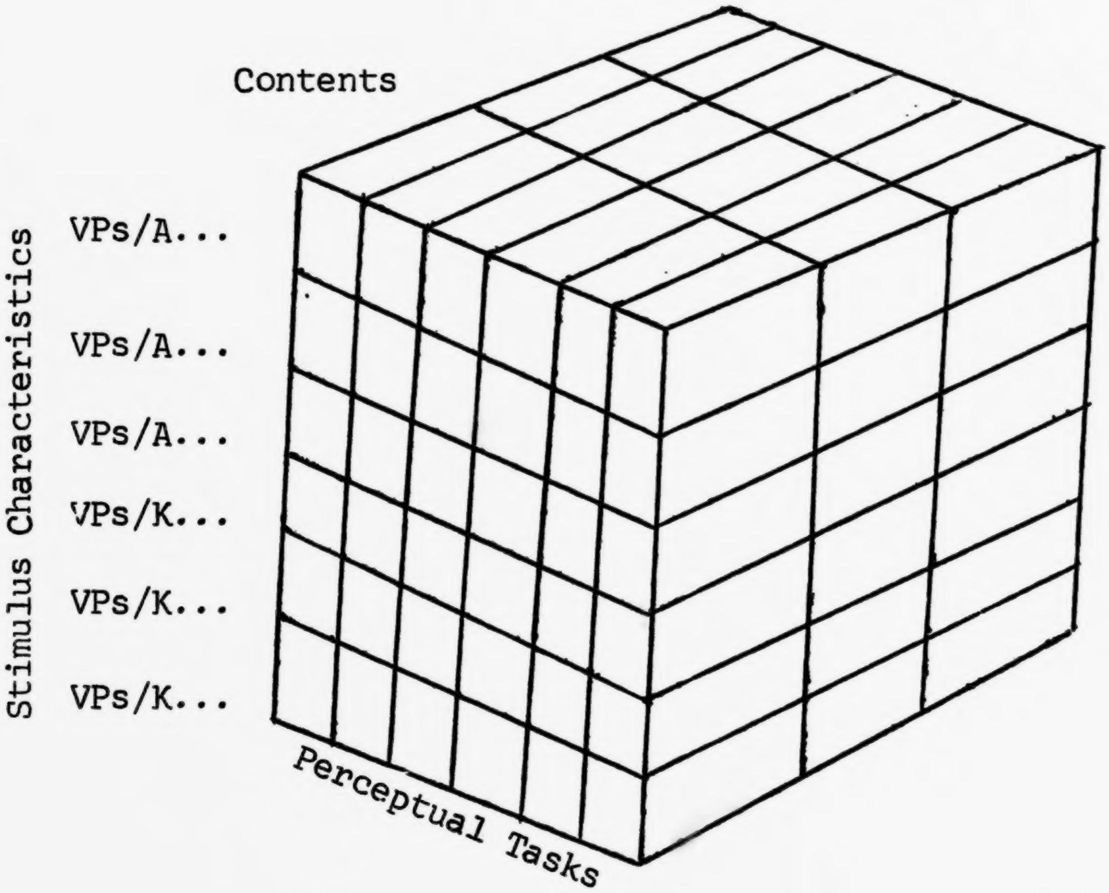

Figure 4

Inter-Modal Stimulus Characteristic Combinations

V = vision, Ps = position in space, A = audition, K = kinesthesis. Dots represent possible combinations involving Ps and each of the various stimulus characteristics within the auditory and kinesthetic modalities.

process. For example, visual form perception occurring under time limitations using a recognition task and figural content describes an operational definition of perception. The concept of speed of processing information, which could be associated with this description, infers something about the process of perception.

The structure of perception model provides a middle ground between theory and operational definition which clarifies the meaning of theoretical constructs and highlights potential limitations in the generality of such constructs. For instance, in the above example the meaning of the construct speed of processing information is clarified by relating it to the model definition: visual recognition of figural forms. In addition, the model definition suggests questions about the generality of the speed of processing construct. Specifically, it raises the issue of whether or not speed of processing information would be measured if various components of the model definition were altered.

Complexity Specification and Reduction

Typically a theoretical structure is an attempt to simplify the complexities of observed events. It is an effort to account for an abundance of facts in terms of a minimum number of relationships. The central function of the structure of perception model is to specify complexity rather than to reduce it. This is not to say that reduction of complexity is not desirable. Indeed, a primary goal of the model is to facilitate attempts to reduce the complexity of categories defining perception. However, the model assumes that complexity reduction requires complexity specification.

The specification of complexity accomplishes two things: First, it provides a systematic detailing of features of perception which must be considered in efforts to reduce complexity. Second, it makes the refinement of theory compatible with complexity reduction.

Complexity cannot be reduced if it is not recognized. Psychological theory is replete with examples of unwarranted generalizations which have arisen as a result of overlooking the complexity of events being studied. The possibility of overlooking salient factors in efforts to reduce complexity can be minimized by linking such efforts to attempts at complexity specification.

A long-overlooked problem in the utilization of scientific theory is that of insuring the compatibility of theory refinement and complexity reduction. The refinement of scientific theory and the reduction of complexity with respect to the explanation of observed events are typically mutually exclusive outcomes. Results supporting a theory are highly desirable because they eventuate in a reduction in complexity. Yet the occurrence of supportive results does not lead to a refinement of theory. The scientist who receives support for a theory from data does not need to alter the theory.

Specification of complexity makes it possible to make theory refinement and complexity reduction compatible. The structure of perception model illustrates this fact. The model hypothesizes the existence of separate abilities for all of the definitions represented in the structure. The discovery of relationships among perceptual abilities, while eventuating in a reduction in complexity, does not support the model. The structure must be altered whenever relationships are found. Thus reduction in complexity is accompanied by refinement in theory.

Methods for Reducing Complexity

Efforts to apply science to educational practice and to other fields often do not include recognition of the fact that the hypothesis testing approach provides only one of many means for reducing complexity. In some instances hypothesis testing does not offer an appropriate or practical approach to complexity reduction. In other instances the hypothesis testing method can and should be combined with other approaches. The material which follows is a discussion of possible ways for reducing complexity associated with the structure of perception model.

Procedures for reducing complexity can be grouped into two headings: category selection and category combination.

Reduction by Category Selection. Selection reduces complexity by defining substructures which eliminate certain definitions of perception from consideration. Reduction by selection is determined by two factors: the relevance of definitions with respect to whatever goals are to be achieved by selection, and the procedures or strategies used in the selection process.

Definitions of perception within the model can be selected on the basis of their relevance to the achievement of some goal. For example, if one's goal were to study relationships between perception and reading, a set of priorities with respect to the relevance of various aspects of perception in reading could be established prior to conducting any investigations. Visual perception is clearly more important in reading than olfaction, taste, pressure sensitivity, and so on. Selection based on goal relevance would suggest that visual perception be studied and the other senses listed be eliminated from consideration. There is some risk in eliminating topics on the basis of relevance, but the risk is far outweighed by the savings in time and expense which result from this method.

The first step involved in the reduction of complexity based on relevance is to specify goals and the tasks involved in achieving them.

System theory provides a useful means for accomplishing this. The achievement of goals typically involves the interrelated functioning of several components. A plan to insure goal achievement must include a description of the overall goal, numerous subgoals, and the tasks and operations attendant to reaching them. With the advent of system theory, a powerful tool for describing the complex interactions involved in goal achievement became available. The consideration of individual tasks and subgoals not as isolated entities, but as components of a system functioning to accomplish an overall goal, makes it possible to specify and to evaluate tasks and subgoals by relating them to the overall goal.

A commitment to the system theory approach is useful not only in reducing complexity, but also in suggesting a redefinition of the concept of ability and its application to the structure of perception model. Abilities are typically defined without reference to the tasks in which they are used. For example, it is known that there is a relationship between intelligence and reading ability. But how does intelligence function in the reading process? What is needed to answer questions like this is a description of the task of reading (what in system theory is called a job description) and an analysis of the psychological processes necessary for carrying out the task, (in system-theory language, a task analysis).

Task analyses based on job descriptions could provide a framework for defining abilities on the basis of their relationship to task performance. For example, the reading task requires the reader sequentially to take in units of information visually. One unit of information must be processed to a sufficient extent to allow additional information to enter the system before the next unit can be received. The faster the reader can accomplish information processing, the faster he should be able to read. Speed of processing information about semantic forms, then, could be defined as an ability.

The above approach defines abilities by specifying psychological processes as they occur during task performance. Concepts like intelligence, creativity, perceptual ability, and so on do not describe the way human beings function in carrying out tasks.

The specification of the operation of abilities in task performance could prove useful in relating consideration of abilities to training and evaluation efforts in education. The area of reading offers an illustration of this possibility. Defining abilities in terms of their operation during reading could lead to the design of programs which not only would provide instruction and evaluation in reading, but also would give instruction and evaluation in the abilities necessary for reading to occur.

Selection is typically a sequential process involving many choices. The number of choices necessary to achieve a goal can vary with the strategy used to make choices. Consequently, complexity reduction is affected by strategy.

A variety of selection strategies can be used to reduce complexity associated with the structure of perception model. Model simplification could be achieved by using a random sample of definitions of perception to represent the structure of perception. For example, a substructure based on random selection might be applied to the study of perception and reading as follows: Information concerning the contribution of perception to the reading process might be attained by randomly selecting definitions of perception from the structure of perception model and assessing the relationships between perception measured in terms of these definitions and reading achievement.

Bruner et al. (1956) have described three selection strategies which could be used to reduce complexity: conservative focusing, focus gambling, and negative focusing. All of these strategies apply in situations in which the goal of selection is to determine what definitions of perception properly belong within a given category.

Conservative focusing as applied to the structure of perception model is an attempt to reduce complexity by minimizing the number of choices necessary to group definitions of perception into categories. To apply this strategy to the model, one would determine category membership by selecting a definition of perception which clearly belonged within a category. Then one would eliminate irrelevant components from consideration by testing successive hypotheses which always involved all but one of the components of the definition originally selected. For example, consider the application of conservative focusing to the problem of determining whether or not the category designated as ability in speed of processing information generalizes across stimulus characteristics, contents, and tasks. An investigator interested in this problem might begin by selecting visual form perception occurring under a time limitation using a recognition task and semantic content as an example of the category. He then might introduce alterations in stimulus characteristics, content, etc., to test the relevance of these components. Under this procedure some components very likely would be eliminated from consideration almost immediately. For example, the first alteration in the perceptual task component might yield significant changes in performance. If this were to occur, it would not be necessary to vary that component further since it would be evident that speed of processing information ability did not generalize across tasks. This example illustrates the advantage to the conservative focusing strategy: namely that it reduces the number of choices necessary to determine category membership.

Application of focus gambling to the structure of perception model differs from the application of conservative focusing in only one respect: Variations occur in more than one component of a perceptual definition at a time. The focus gambling strategy has the potential to reduce the number of choices necessary to determine category memberships to an even greater extent than is the case with conservative focusing. However, there is a risk involved in applying the strategy. If in changing two or more components, it is determined that the perceptual definition under study is no longer measuring the same thing as assessed by the originally-selected definition, there is no way of knowing which of the altered components is responsible for the alteration in performance. Thus additional selections must be made.

Negative focusing may be applied to the model to determine category membership in disjunctive categories. For example, suppose disabilities in reading caused by lack of ability in speed of processing information were a disjunctive category involving sets of definitions from the visual and auditory senses. If this were the case, poor performance in reading could be related to either a lack of auditory speed or visual speed. The proper approach to prove the relevance of these two senses would be first to find children who did not exhibit reading disability. Then groups of children would be assessed, each of which differed from the original group on only one potentially relevant variable. If speed of processing disabilities in reading were actually a disjunctive concept, each time a relevant component were introduced reading disability would appear. The appearance of the disability would attest to the relevance of the newly introduced component.

Reduction by Category Combination. Complexity reduction resulting from combining categories can occur in two ways: The first results from hypothesized and demonstrated relationships which indicate that categories should be combined, and the second results from defining a hypothetical construct which includes several categories.

The classical scientific approach, involving hypothesis testing based on theory, provides a way of reducing complexity, the value of which has been demonstrated on countless occasions. There is no reason that this approach could not be applied to the structure of perception model. Indeed, if it were successfully applied, a most beneficial reduction in complexity might be achieved. If, for example, it were to be hypothesized and demonstrated that certain perceptual abilities generalized across perceptual tasks, a useful simplification of the structure of perception model would be effected.

A second way to reduce complexity by combining categories is to create a hypothetical construct which includes more than one category. The best known example of a hypothetical construct combining categories is the construct of intelligence. The items and/or subtests on an intelligence test typically represent a wide variety of tasks which in many cases are not highly related. Presumably because of their predictive value, the items are grouped into a single construct, intelligence. Since most criterion behavior, especially in education, is highly complex, the chances of accurately predicting criterion performance are enhanced by grouping items in this way.

The hypothetical construct approach could be used to reduce complexity in the structure of perception model. A large number of definitions of perception, each bearing some degree of relationship to various criterion behaviors such as achievement test performance, could be grouped into a single test measuring "perceptual ability". The central advantage of this kind of procedure is that it enhances prediction. The central disadvantage to the method is that it does not relate the definition of perception to task performance.

The Structure of Visual Perception

The perceptual measures presented in later chapters of this report may be defined in terms of the model given in Figure 5, Page23. Each cell in the model represents a definition of visual perception formed by the combination of a stimulus characteristic, content, and perceptual task. Some examples of intra- and inter-modal interactions are given.

Stimulus Characteristics. Below is a description of the stimulus characteristics for visual perception and some discussion of the dimensions which define them.

Form refers to the structure or shape of objects. Efforts to define form in terms of quantifiable dimensions have been extensive and the problems associated with them formidable. Many dimensions have been isolated and studied. However, the task of identifying dimensions is by no means yet complete. A detailed review of the literature dealing with the dimensions of form has been presented by Michels and Zusne (1965). These writers describe three kinds of form dimensions: transitive, transpositional, and intransitive. Transitive dimensions are defined by quantitative variations in structure and information content.

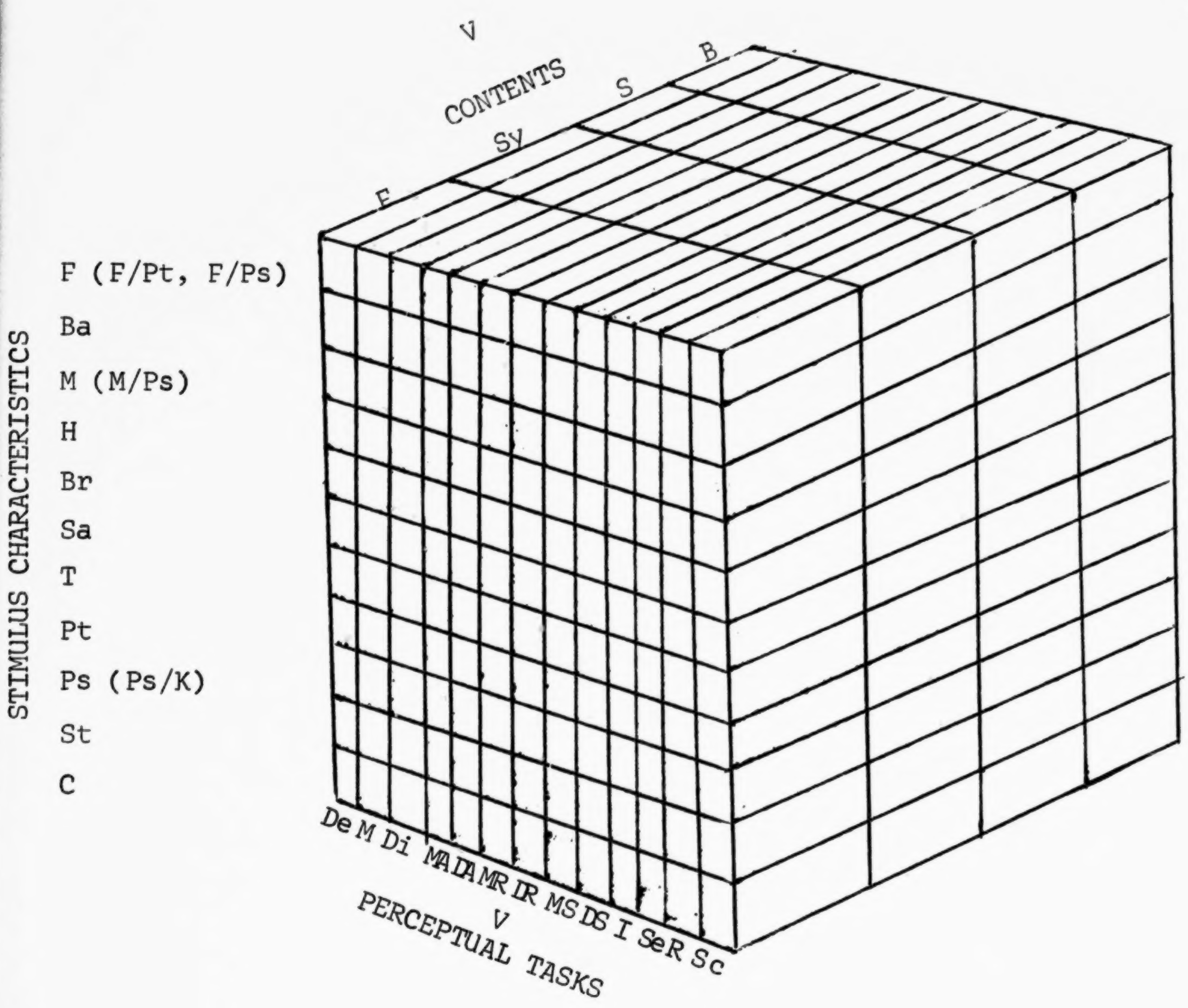

Figure 5

The Structure of Visual Perception

Sense Modality: V - Visual, Contents: F - Figural, Sy - Symbolic, S - Semantic, B - Behavioral, Stimulus Characteristics: F - Form, F/Pt - Form limited by time, F/Ps - Form limited by spatial position, Ba - Background, M - Magnitude, M/Ps - Magnitude limited by spatial position, H -Hue, Br - Brightness, Sa - Saturation, T - Texture, Pt - Position in Time, Ps - Position in Space, Ps/K - Spatial position limited by kinesthetic input, St - Stability, C - Change; Perceptual Tasks: De - Detection, M - Matching, Di - Discrimination, MA - Match Adjustment, DA - Discrimination Adjustment, MR - Match Recognition, DR - Discrimination Recognition, MS - Match Scanning, DS - Discrimination Scanning, I - Identification, Se - Selection, R - Reproduction, Sc - Scaling.

An example of quantification along a transitive dimension is the number of inflections in the contour of a shape, i.e. the number of sides it has. Alteration of the number of sides changes the shape of the object and the amount of information associated with it.

Transpositional dimensions involve changes which do not affect structure or information content. Size and spatial position are two examples of transpositional dimensions. In the present model, the dimensions which Michel and Zusne group under the heading of transpositional dimensions are considered to be stimulus characteristics separate from form.

Intransitive dimensions are defined by quantitative variations in structure, but not information content. Changing the length of the base of a triangle is an example of variation along an intransitive dimension. The object changes shape, but it remains a triangle. Its structure is altered, but its information content remains the same.

Background is the field in which a figure or form exists. Background is defined in part by the boundaries of the figure it contains and in part by its own structural makeup. Presumably background is defined by the same dimensions which define form. However, this may not be the case. Current literature is lacking in studies dealing with the dimensional character of background.

Magnitude, hue, brightness, saturation, and position in time require no comment. They are all well known unidimensional characteristics.

Texture refers to the discriminable characteristics of the surface of an object. Texture, like form, involves structure or pattern and is multidimensional. Systematic investigations into the dimensional nature of texture are lacking at the present time.

Position in space refers to the location of an object in three-dimensional space.

Stability is the extent to which an object remains the same over time with respect to one or more of the dimensions which define it. Conversely, change refers to alterations in one or more dimensions over time. Stability and change are characteristics of characteristics. An object has a certain stability of form, stability of size, stability of spatial position, and so on. Similarly an object can change with respect to form, size, position, etc.

The above description of stimulus characteristics indicates wide variation in the ease and clarity with which dimensions defining stimulus characteristics can be specified and in the complexity of stimulus characteristics. Size on the one hand is easy to define and quantify. Form, on the other hand, is highly complex and difficult to dimensionalize.

Perceptual Tasks. The following list provides descriptions and gives examples of the perceptual tasks in visual perception. All of the perceptual tasks listed involve making judgments concerning a standard. Standards can be external or internal. For example, adjustment of a rod to the apparent vertical involves an internal standard: the perceiver's internal representation of verticality. Recognition of words flashed on a screen involves an external standard: the flashed words. With the exception of scaling tasks, which typically do not make use of external standards, the list given below describes tasks with external standards. Corresponding descriptions could be given for tasks with internal standards.

Detection indicates perception of something without specifying what has been perceived; e.g. indicating whether or not a word has flashed on a screen within a given time period.

Matching involves judging the similarity between stimuli; for example, judging whether or not one design is the same in shape as another.

Discrimination is judging differences between stimuli.

Match adjustment is adjusting a variable stimulus to match a standard; for example, adjusting a circle which can vary in size to match the size of a standard circle.

Discrimination adjustment is adjusting a variable stimulus until it is different from a standard.

Match recognition is selecting from a series of alternatives the stimulus which matches a standard; e.g. selecting a word from a prepared list to match a word flashed on a screen.

Discrimination recognition is selecting from a series of alternatives the one which is different from the others; e.g. selecting the shape which is different from the other shapes in a series.

Match scanning is finding other examples of a standard stimulus in a complex stimulus situation; e.g. finding all of the circles in a large group of geometric shapes.

Discrimination scanning is judging whether complex stimuli are the same or different in all respects; e.g. discriminating between two words which are the same except for their ending letters.

Identification is denoting what is seen; e.g. naming words flashed on a screen.

Selection is indicating what is perceived in a complex and sometimes ambiguous stimulus situation; e.g. telling what is seen in an ink blot. The blot is an ambiguous stimulus capable of giving rise to a large variety of responses.

Reproduction is duplicating a standard; for example, copying a square.

Scaling is arranging stimuli with respect to a given characteristic; e.g. arranging sticks in order from the largest one to the smallest one. There are several scaling procedures. For a detailed discussion of these, see Dember (1960).

Contents. The content categories used in the model are closely related to those specified by Guilford (1960) in connection with his description of the intellect. Figural content is concrete material; for example, geometric shapes. Symbolic content is composed of signs, e.g. numbers, letters, etc. Semantic content refers to meaningful verbal units; e.g. words, phrases, and sentences. Behavioral content refers to social stimuli; e.g. facial expressions, gestures, etc.

In Guilford's model, whether or not a stimulus, e.g. a word, is described as semantic or symbolic depends on the task associated with the stimulus. For example, if the task were to define the word, the content would be semantic. If the task were to recognize the word, the content would be symbolic. In the structure of perception model, content is defined by stimulus type and not by task characteristics. Words, for example, are described as semantic regardless of the tasks in which they are used.

The Structure of Perception and Educational Practice

The structure of perception model is intended to provide a guide for research and a vehicle for linking research and practice. As pointed out above, the model generates definitions of perception and provides a basis for establishing the scope of perceptual theory. In addition, the model, linked with system theory, is being used to provide a framework within which to identify and provide measures of perceptual abilities relevant to education. The studies described in later chapters of this report are examples of this use. The model also could be used to add clarity to the definition of perceptual measures currently in use in the schools. The use of perceptual tests in education particularly in the elementary school is widespread. If these tests were to be defined in terms of the model, the difficult task of making comparisons among them with respect to the scope of abilities measured would be greatly simplified.

CHAPTER II

THE PERCEPTUAL SYSTEM

John R. Bergan

The structure of perception model presented in the last chapter classifies perceptual acts in terms of variables capable of imposing limitations on perception. It is useful in providing a systematic way to determine the limits within which a given perceptual theory can be applied and it aids in discovering the limits of perceptual abilities.

The perceptual system model is an effort to describe the functions of the components in the perceptual process. The model, shown in Figure 6, Page 30, provides a framework within which to consider the perceptual studies described in this report. The model is broad in scope and is intended to provide a basis for a series of investigations into the nature of content-associated individual differences in speed of information processing abilities. The components within the model are functional units representing the activities involved in the perceptual process.

Control

The control component serves three functions: it generates stimulus classification structures (internal arrangements of stimulus representations) it directs the operations of the evaluation component, and it orients the organism to perceive, i.e. regulates attention. Control operations are regulated by structures built into the component through the interaction of hereditary and experiential factors. These structures are capable of being influenced by information from the other components.

Reception

The reception component serves to transform information from the

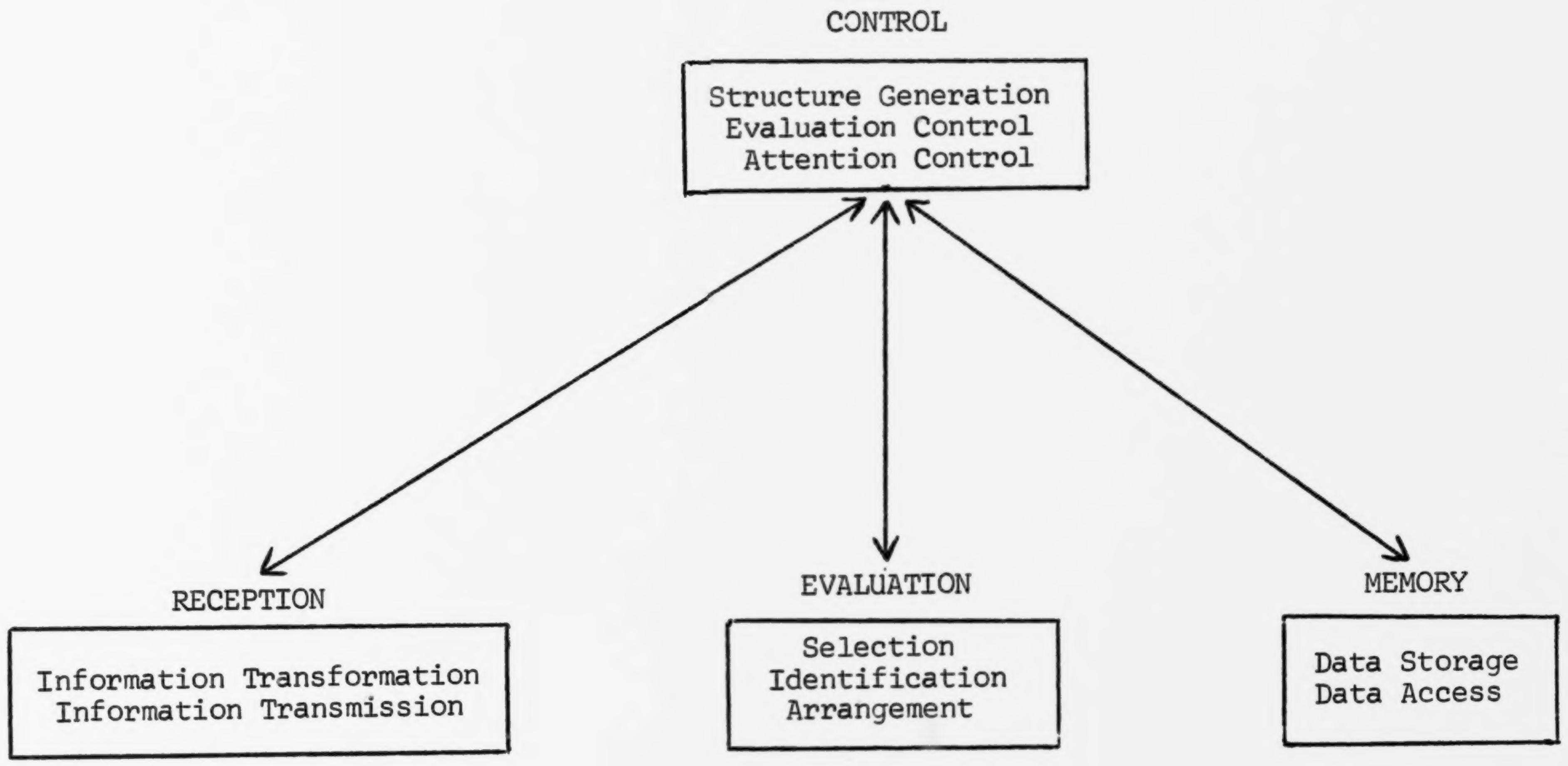

Figure 6. Arrows indicate the flow of information in the system. Feedback to the control component provides a basis for monitoring the effects of control operations and for making modifications in control procedures.

environment into sensory information and to transmit such information to the evaluation component of the system.

Memory

The memory component contains the data used in generating stimulus classification structures, and an access system which permits data to be called by the control component. Data consist of internal representations of objects and events.

Evaluation

The evaluation component conducts three kinds of operations: selection, identification, and arrangement. Selection operations serve the purpose of determining whether or not information should be retained for processing or should be discarded. In selection, information is compared with units in a stimulus classification structure. If the information matches the appropriate stimulus classification units, it is retained for further processing. If not, the information is discarded.

At this point the relationship between the concept of expectancy and stimulus classification structure may be noted parenthetically. Expectancies are stimulus classification structures used in selection operations.

In identification operations, the evaluation component makes comparisons of units of incoming information with units currently in operation within the classification structure. For each unit to be tested within the classification structure, a decision must be made as to whether or not the incoming stimulus matches that unit. The identification process requires a plan of search of the classification structure in operation and a set of rules for decision making.

Arrangement operations involve ordering stimuli on the basis of some dimension or dimensions; for example, stimuli might be arranged in order on the basis of size from the smallest to the largest. Piaget (Flavell, 1963) has made extensive studies of the cognitive structures involved in stimulus ordering.

The Concept of Stimulus Classification Structures

Definition. Stimulus classification structures are conceived as internal arrangements of stimulus representations. Representations may be of three types: the imagery type, the label type, and the concept type. Imagistic representations are thought to provide standards against which incoming stimuli are judged; for example, to identify a number, a perceiver would make a series of comparisons involving an external stimulus number and images within a stimulus classification structure of the configurations of possible numbers. Label representations provide names for stimuli. For example, judging numbers may involve application of a verbal label such as "five" or "seven". Conceptual representation refers to the classification of a stimulus in terms of some category. For instance, either the verbal label "five" or the imagistic representation in the above examples might represent the concept, five.

It is assumed that perceptual recognition occurs when an incoming stimulus is classified in terms of one or more of these three types of representations. Recognition of a number flashed on a screen could involve comparison of the number with imagistic representations of numbers, application of a label, and categorization of the number as a particular quantity.

Generation. Stimulus classification structures are thought to be generated in three ways: by classification, by association, or by some combination of these two. A structure generated by classification would be composed of units selected on the basis of class membership. For example, if a subject were asked to identify geometric shapes flashed on a screen, he might construct a stimulus classification structure composed of such categories as size, type of figure (triangle, square, circle), etc. A stimulus classification structure built on the basis of association would involve units related through past experience. For example, if a perceiver were asked to identify a group of words such as "sky is blue", identification of the first word could be used in the formation of a stimulus classification structure which would contain words associated in the past with that word. A combination of association and classification would involve associations related to classes. For instance, in the example, "sky is blue", the perceiver might, in addition to using association, identify the middle word from the category, short verbs.

Classification Structures and Perceptual Efficiency

The concept of stimulus classification structure was devised to provide an explanation for how incoming information might be categorized efficiently. It has long been recognized through concepts like expectancy, set, and attention, that perception requires limiting the amount of information received from the environment. At any given instant there is much more information available to the senses than can possibly be processed. The concept of stimulus classification structures gives parallel recognition to the necessity for limiting the amount of previously stored information considered in categorizing stimuli. The processes of matching incoming information to internal stimulus representations, labeling the information, and categorizing it, requires making a series of comparisons involving the incoming stimulus and an indeterminant number of internal representations of stimuli. The number of comparisons to be made would be inordinately large if there were no structures to reduce the number of representations considered.

CHAPTER III

PERCEPTION AND READING

Elaine R. Nicholson

Historical Overview

Initially, the major emphasis of research concerned with determining the underlying causes of difficulties with reading was medically oriented. The first description of special reading disabilities in otherwise normal children in medical literature was made in 1896 by an English school doctor, James Kerr. "Congenital word blindness" was the term used by Morgan (1896, p. 1378), an English oculist, to describe such special reading problems which he concludes were due to a congenital injury to the "reading centre" in the brain (Malmquist, 1958). Hinshelwood (1917), in agreement with Morgan, pointed out that difficulties in understanding and interpreting printed words were not due to specific ocular effects, but were the result of a pathological condition in which the brain was undamaged in other areas. The premise was that the damage was centered within the *"visual memory centre"*.

Kussmaul (1877) asserted that word blindness was not necessarily congenital, but rather was the result of disease affecting visual perception. A person who suffered from "acquired word blindness" could see the printed words, but was unable to make identifications, a loss of a previous ability. Elaborations of Kussmaul's view were suggested by Lashley (1929), who maintained that the organization of the brain's functions were thrown out of order, and Bachmann (1927) who related reading disabilities to associative defects.

Unfortunately, the above remained unconfirmed hypotheses which had their bases in theoretical premises and depended upon informal observations. Many educational psychologists could not agree (Skydsgaard, 1942; Tordrup, 1955; Malmquist, 1958; Monroe, 1946) with the medical view that those children suffering from a specific disease, "congenital word blindness", made distinctive reading errors which could be considered as being characteristic of a specific psysiological disorder. A vast variety of reading errors were observed in children with reading problems and the only generalization which could be made was that the number of errors for such children was greater than was the case for normal readers. It is now recognized that many factors, including perceptual difficulties, may contribute to reading disabilities (Robinson, 1955; deHirsch *et al*., 1966).

Relationship of Intelligence to Reading Ability

Medical investigations in the late 1880's usually did not consider intelligence as a factor in reading disabilities, partly because it was not within their chosen domain of research and partly because their original case studies included persons described as having normal levels of intellectual functioning (Hinshelwood, 1917; Skydsgaard, 1942).

The attitude of researchers toward the contribution of intelligence to reading had markedly changed by the early 1930's. A number of investigators (Deputy, 1930; Hayes, 1933; Tinker, 1932; Davidson, 1931; Gates, 1947) considered intelligence to be a most important factor in predicting future reading ability. Research has strongly supported this view. Malmquist (1958) reported numerous studies revealing correlations from .40 to .60 between intelligence and reading ability. Deputy (1930) found a correlation of .70 with reading using the Pinter-Cunningham Primary Mental Test with first-grade children.

Investigators have attempted to establish a minimal level of intelligence as being necessary for learning beginning reading skills. Gates (1930, p. 14) asserted, "It is a remarkable achievement to teach any child of less than 65 I.Q. to read new material unassisted." Others have set mental age limits at which reading instruction can be undertaken with profitable results. Morphett and Washburne (1931) and Rosebrook (1935), according to Malmquist (1958), held that a mental age of 6½ to 7 years was required to read, while Merrill (1921) found few benefits from beginning instruction with children whose mental age was below six years.

On the other side of the picture, some researchers have not found significant relationships between intelligence and reading ability. Harrington and Durrell (1955), using the Otis Quick Scoring Mental Ability Test (Alpha, Form A) with second graders, found that mental age had little relationship to reading achievement. The results of her extensive studies concerning first grade reading difficulties led Malmquist (1958) to emphasize that poor reading ability need not be described as being due to subnormal intelligence. However, the results did confirm the view that intelligence is an important factor in reading success.

One especially important finding with respect to the relationship between intelligence and reading is that correlations between reading and intelligence tend to be highest at the upper grade levels. Bond and Tinker (1957) reported a correlation of only .35 between intelligence and reading achievement at the end of first grade, while a correlation of .65 was observed at the end of sixth grade. Lennon (1950) found correlations of .34 at the second-grade level and .85 at the eighth grade level. Although these findings might be interpreted as meaning that intellectual functioning plays a greater part in the reading process on the higher reading levels and is, therefore, more closely related to reading ability, Lennon related his results to differences between intelligence tests used at different age levels. Similarly, Harrington and Durrell (1955), who found little influence of intelligence on reading success, felt that the fact that the mental test they used was primarily a measure of oral language comprehension may have affected their results.

In accordance with this reasoning are the contentions of Ladd (1933, pp. 21-22):

> It seems that correlations between reading and Binet intelligence tests average about .50, but may be greater or less according to the range of the group tested, the correlations between reading and verbal group intelligence tests are usually about .60 to .65, sometimes higher but seldom lower and the correlations between reading and non-verbal intelligence tests are very much lower.

Perception and Intelligence

Gates (1926) found that mental age as measured by the Stanford-Binet Test had a high correlation with his perceptual tests containing verbal material and low correlations with non-verbal tasks. Sister Mary Phelan (1940) reported a study in which the relationship between mental age and reading achievement was .499 on the first-grade level.

In the same study, the correlation between visual discrimination and reading was .432. She compared these results to her own fourth- and fifth-grade sample and concluded that visual perception contributes less to reading on the upper levels than intelligence.

Using the Frostig instrument, Sprague (1963) found a correlation of .235 with the Goodenough Intelligence Test using kindergarten children and .273 with the same children when in first grade. It was decided that the low correlations indicated the measuring of relatively distinct factors by the two instruments. Malmquist (1958) found a correlation of .415 between her total visual perception test scale and intelligence on the first-grade level. Furthermore, she found a higher correlation between visual perception and reading comprehension (.326) than between visual perception and a reading test (.227) designed to measure mechanical aspects of reading.

Goins (1958) found substantial relations between intelligence and her tests of Pattern Copying (.477) and Figures (.451). Leton (1962, p. 414) has suggested that, "The common variance in reading readiness and intelligence scores is largely due to the mutual assessment of visual-motor capacities."

Corah and Powell (1963) undertook a factor analytic study of the Frostig Developmental Test of Visual Perception with nursery school children. Using the Full-Range Picture Vocabulary Test (Ammons and Ammons) as a measure of intelligence, they observed a relationship of .386 with the Frostig Perceptual Quotient. They found a general intelligence factor with moderate loadings on Frostig subtests of Eye-Motor Coordination, Position in Space and Spatial Relations. The other major factor that was extracted tended to be one of developmental changes in perception.

Olson (1966) using second graders, measured relationships among Frostig subtests and the California Short-form Test of Mental Maturity. He found that the Eye-Motor Coordination subtest did not correlate significantly with either I.Q. (.18) or mental age (.21). The Position in Space subtest did not correlate with mental age (.15), but did with I.Q. (.26). The Spatial Relations subtest correlated significantly with I.Q. (.26), but not with mental age (.18) and I.Q. (.372). The

Frostig total scores were related to mental age at .31 and with I.Q. at .38. The results involving nursery school children and second graders in the above studies were similar.

Relationship of Visual Perception to Reading Ability

The earliest investigations of the relationship between perception and reading were concerned with the measurement of eye movements. The perceptual process in reading, therefore, received the focus of attention in research. Malmquist (1958) attributes the undertaking of investigations into the conditions of eye movements in reading to a French oculist, Javal. In 1878, he discovered that "the eye traverses the lines of printed or written material by a series of movements and pauses, and not, as had hitherto been supposed, by a continuous passage along the lines." The results of early eye movement studies, according to Malmquist (1958), have demonstrated wide variations in number of fixations and regressions across age levels and within age levels, but not across reading ability levels.

Gates (1926, p. 436) studied relationships among various perceptual tasks in order to determine if there was a general perceptual ability. His results led him to say: "What we call visual perception is not a single, unitary capacity or power which operates uniformly upon all sorts of data and under all conditions; perception, on the contrary, is specialized." Gates undertook to correlate his tests with reading achievement in grades one through seven and found that "word perception" was the most closely related to reading with intelligence having the next highest and perception of digits and geometric figures having only slight correlations with reading.

Sister Mary of the Visitation (1929), using fourth- and fifth-grade children and the tests constructed by Gates, found a group factor suggesting a general perceptual ability. Fendrick (1935, p. 51) felt his test results indicated a specific perceptual factor in reading ability. "Group differences were found that indicated a more efficient performance on the part of good readers in certain tests of visual perception."

Another approach to visual perception, as reported by Goins (1958) was that of considering it as a primary mental ability. "The issue implied was: Is there a primary, an inherent, visual perception ability or factor that accounts for part of the individual differences in reading skill?" Langsam (1941), in a factor analysis of various reading abilities, found a factor which had functional unity with a general test of visual perception. Goins (1958, p. 12) cited the work of L. L. Thurstone and Thelma Thurstone in which they defined the perceptual function as a "facility in perceiving detail thatis imbedded in irrelevant material." This work will be referred to in greater detail in a later section of this paper.

The studies of Gates, Sister Mary of the Visitation, and Sister Mary Phelan demonstrated a positive relationship of visual perception to reading achievement. The correlations were low only when the perceptual content included material not like that in reading matter. An argument put forth in support of a general perceptual ability by Stroud (1945) explained the closer relationship of tests using words and letters as being due to the practice of such content at early school:

> Were standard geometric designs used and were likewise made the object of specific instruction in school for from four to six years, it is thinkable that they likewise would correlated with rate of reading scores to as high a degree as do the other tests.

Frank (1935), as reported by Malmquist (1958), postulated that reading disabilities are caused by the lack of maturity of the perceptual processes. Her findings correspond to those of deHirsch (1966) in which the retarded reader who is older is still at the same level of visual perception functioning as the beginning reader. Malmquist (1958) found a relationship of .31 (significant at the .01 percent level) between visual perception tests and a composite reading index. Olson (1966) reported that in a study of second-grade children the correlation between the Frostig Developmental Test of Visual Perception total score and the California Achievement Test was significant at the .01 percent level and that all subtests contributed to the correlation except Form Constancy.

Relationship of Specific Visual Perception Abilities to Reading Ability

Thurstone (1938a, pp. 81-82) undertook studies in order to delineate more clearly his initially defined perceptual function or "P-factor" and ist psychological nature:

> The perceptual function here seems to be a facility in perceiving detail that is imbedded in irrelevant material. The simplest expression of this function would be a task in which the subject is asked to identify some particular detail that is buried in distracting material. Given the task to find a particular word in a page of print, some people seem to be able to locate it by a dispersed attention to the page as a whole, while others require systematic search through each successive line of print.
>
> It might be suggested here that the various tests for reading readiness of young children are probably good examples of the factor P. If this should be verified, it would be psychologically interesting to determine whether slow and fast readers can be differentiated by the factor P under similar conditions of practice in reading. It will also be of interest to determine to what extent this factor is involved in what is sometimes called "quick intelligence" as distinguished from its more analytical and reflective aspects.

Thurstone (1938b, p. 9), constructed a battery which included nine tests designed to measure perception. His results seemed to indicate that the common factor in the tests was fluency of association with perceptual material. He stated, "It is probably that this factor is of considerable significance in determining the speed of reading, and it may be involved in reading disabilities." The description of the P-factor was then to include "fluency of association with perceptual material" and renamed "Perceptual-speed factor P". Further study of this factor (1944) revealed five factors which seemed to be concerned with speed of different functions: reading time, speed of perception, speed of judgment, speed and strength of closure, and rate of reversals in perception. The speed of closure seemed to involve the strength with which a stimulus configuration was held against distractions. The other important factor seemed to involve the manipulation of two configurations simultaneously or in succession.

Thurstone then set about to determine whether or not these factors could distinguish between fast and slow readers using college students. His general conclusion was that the fast readers were more fluent in making associations. He stated that, "Reading is primarily a perceptual function in which the subject makes associations quickly with rapidly changing visual stimuli." (1944, pp. 129-130)

Later (Thurstone, 1949, p. 16) the two closure factors were identified and sharply defined. C_1 is found in perceptual tests in which "the presented perceptual field has no initial organization and in which the subject is asked to unify the field without any previous structuring." In other words, closure in an unorganized field or unification of a complex situation. C_2 is more closely connected to the original P-factor of "the ability to keep in mind a configuration in a distracting field," and is further defined here as a strength of closure in how well the configuration can be retained.

Goins (1958), in her extensive work using first graders, limited her perceptual tests to non-verbal tasks. Using fourteen tests, she isolated two perceptual factors, one of which was not related to reading achievement. The purest measure of this latter factor showed no significant correlation with reading test scores. Two of the tests which loaded on this factor, Identical Pictures A and Identical Pictures B, were originally designed by Thelma Thurstone as tests measuring "perceptual speed". However, because of the nature of the tests which loaded on this factor, Goins felt the factor may not merely measure speed of perception, but also the ability to hold a configuration in mind during rapid perception. She felt that these findings were significant because of the general use of tests of this nature in reading readiness inventories when her results ruled out their use as indicators of the perceptual components of the reading process. The factor P-2, which was highly related to reading achievement, appeared to be a closure factor highly congruent with Thurstone's factor C_2. She concluded that this factor measured an ability common to the reading process and that reading achievement at the first-grade level depended a great deal upon ability in this perceptual ability.

The findings with regard to visual perception of letters and words have been reported above. Barrett (1965a) found that perception of letters and numbers was most highly correlated to reading achievement. He also found that Pattern Copying (Goins' test) was more useful in predicting Word Recognition than in Paragraph Reading. This substantiated Goins' findings that the Pattern Copying subtest produced the highest correlation with reading scores (.519). It also had the highest loading on the perceptual closure factor, P-2, (.930), a factor on which reading achievement loaded to an extent of .600. The Reversals Test and combined perceptual score were most highly related to reading achievement.

Her results showing relationship between non-verbal perceptual tasks and reading achievement were contrary to earlier studies and also substantiated the premise that visual perception is quite important at the beginning stages of reading instruction.

The results of Malmquist's study demonstrated that comprehension of and discrimination between letters (.31) and numbers (.33) were more closely related to reading achievement than was visual perception of geometric figures and the ability to hold in mind a shape or picture involving distracting elements. Her dichotomy of perceptual abilities was described as perception of letters and numbers on one hand, and the ability to discriminate between rather similar optical patterns and structures other than words. This latter ability agrees with both Skydsgaard (1942) and Goins (1958).

Barrett (1965b) reported several studies of visual discrimination of non-verbal material. Using geometric designs, Monroe (1935) found a correlation of .60 with reading. Robinson (1958), however, found a much lower relationship of .24. Keogh (1963) found a correlation of .50 between Bender-Gestalt test scores and achievement. The above three studies all used first-grade children and Barrett (1965b) summarized their findings as indicating that relative relationships will depend on the complexity of the visual and/or visual-motor abilities they measure. Barrett surveyed numerous studies to determine the relative effectiveness of verbal visual discrimination as against non-verbal discrimination. The verbal materials (words) received higher values than did designs, numbers or pictures, and the conclusion was drawn that verbal visual discrimination tests are better predictors of reading achievement in first grade than are non-verbal visual discrimination tasks.

In summarizing the findings of those studies related to verbal or non-verbal perceptual stimuli, it is noted that the earlier studies, having found low correlations when measuring non-verbal visual perceptual abilities, stressed their finding of verbal abilities being more closely related to reading ability (Deputy, 1930; Gates, 1922, 1926; Smith, 1928).

Later studies by Olson (1958), Gavel (1958), and Weiner & Feldmann (1963) further substantiated the use of verbal material in readiness measures. It should be pointed out that in many of these studies there were no relative comparisons between verbal and non-verbal visual discrimination.

Support of non-verbal visual discrimination was found in studies by Barrett (1965a), Bryan (1964), Goins (1958), Monroe (1934), Skydsgaard (1942), Potter (1949), and Robinson (1958). The perceptual measures involved such abilities as visual form discrimination, visual-motor coordination, etc. Factor-analytic studies such as Goins (1958) isolated and described a specific visual perception factor (strength of closure) which was significantly related to reading achievement and another factor (speed of perception), which was not related to reading.

Speed of Information Processing

The literature on speed of information processing (recognition of stimuli flashed on a screen and followed by masking stimuli) provides a possible explanation as to why Goins did not find a relationship between perceptual speed and reading. This literature has been summarized in detail by Bergan (1967). Briefly, a crucial factor in defining perceptual speed is whether or not the target stimulus is followed by a masking stimulus. Gilbert (1959) found a high correlation between reading and perceptual speed when masking stimuli followed target stimuli. The relationship was not observed when masking stimuli did not follow target stimuli. Bergan (1967) observed correlations of substantial magnitude between speed of information processing and reading in elementary school children.

Both the Gilbert and Bergan studies used stimuli with semantic content. The investigations presented in later chapters of this report examine relationships among speed of information processing tests differing in stimulus content.

The importance of content-associated individual differences in speed of information processing abilities is perhaps best appreciated when it is considered within the larger context of the problem of defining human abilities. The influence of content on the definition of human abilities has represented a serious problem in educational psychology since before Thorndike. In the early days of psychology it was assumed quite reasonably that human abilities could be defined in terms of intellectual processes capable of operating on almost unlimited types of stimulus content. For example, it was argued that if a child could learn to reason logically in one subject matter field, he could then apply his acquired reasoning powers with success in other subject matter fields. Assumptions such as this have been put to the test of research on countless occasions and almost without exception have failed to be validated. Abilities involving thought processes applied in one content area are not related to abilities involving the same processes but a different content area. Piaget (Flavell, 1963), for example, has shown that conservation of volume does not necessarily imply conservation of weight. Guilford has demonstrated that cognitive processes such as convergent or divergent production with figural content represent different abilities than convergent or divergent production with semantic or symbolic content.

The influence of content on the generality of abilities has implications for increasing the efficiency and extent of effectiveness of instruction. If it could be assumed that certain perceptual and cognitive processes represented abilities with wide application to different content areas, these processes could be taught and a gain in efficiency and extent of influence of instruction achieved. The hope for establishing such an ability instruction program rests on the discovery of individual differences in abilities and the source of such differences.

CHAPTER IV

COGNITIVE STYLE RESEARCH

Jerry L. Gray

Review of the Related Literature

Gardner (1953) introduced the term cognitive style. Using an object-sorting test, Gardner observed individual differences in the range of different objects that subjects would include in one conceptual category or what he called an equivalence range.

Gardner and Schoen (1962) and Sloane, Gorlow, and Jackson (1963) have found that equivalence range behavior is consistent across such tasks as common objects, photos of people, and sets of described human behaviors. Gardner and Long (1960) have reported individual consistency over three years on two administrations of the Gardner Object-Sorting Tests. However, significant correlations between cognitive styles, based on object-sorting tests, and intellectual abilities have not been established (Gardner, Jackson, and Messick, 1960; Sloane, Gorlow, and Jackson, 1963; and Wallach and Kogan, 1965).

Witkin *et al*. (1962) reported individual consistency in the performance of their subjects on perceptual organization tasks. An important finding from their studies is that young children tend to perceive the overall structure of a complex design, but that with increasing age, children tend to perceive the differentiated parts of such a configuration. Witkin *et al*. called this dimension of cognitive style field dependence-independence. Field independent behavior occurred more frequently in males than females and correlated with measures of intelligence, motivation to achieve, and autonomy in social relations.

Kagan _et_ _al_. (1963) have identified a dimension of cognitive style similar to that of field dependence-independence. They found that there are stable preferences among children to use one of three modes of categorization. Kagan _et_ _al_. view a preference for a descriptive style as an analytic mode and a preference for a relational style as a global mode of organizing experience, similar to field independence and field dependence, respectively. A categorical-inferential style, assumed to be relatively independent of descriptive and relational styles, is an abstract mode of categorization.

Consistent with the findings of Witkin, Kagan _et_ _al_. found developmental changes and differences between the sexes in preferences for cognitive styles. Males used more descriptive concepts than females, and descriptive concepts increased while relational concepts decreased with age among children from the first through the sixth grade. A descriptive style, in contrast to a relational style, was positively correlated to persistence, autonomy in social relations, and motivation to achieve. It appears that both groups of investigators may be measuring something in addition to intellectual abilities, i.e. numerous personality variables.

Kagan _et_ _al_. reported significant correlations between the performance I.Q. on the California Test of Mental Maturity and both descriptive and categorical-inferential style. These relationships are questionable, however, resulting from the ipsative scores inherent in the scoring procedure.

Wallach and Kogan (1965) investigated the relationships among cognitive styles, creativity, and intellectual ability with a sample of middle-class, fifth-grade children. They found that males designated as high in creativity and high in intelligence use categorical-inferential and relational concepts in a more balanced fashion than three other groups of males designated as high and low, low and high, and low and low in creativity and intelligence. These results tend to cast some doubt on the degree of consistency with which a child uses a cognitive style, particularly when a high creativity score is accompanied by a high intelligence score.

Deutsch (1965) used measures of categorization as supplements to tests of intelligence in comparing lower-class children to middle-class children in their intellectual abilities. Deutsch identified what he called a "cumulative deficit phenomenon" which occurs between the first- and fifth-grade in lower-class children when compared to middle-class children. Scores of lower-class children were not significantly different from middle-class children in the first grade on several measures of intellectual ability. By the fifth grade, however, their scores on these tests were significantly lower than the scores for middle-class children. This deficit was attributed to the inability of lower-class children to use abstract categories in identifying their environment.

Bruner *et al*. (1966) studied modes of categorization among middle-class, urban children of above average I.Q. scores, but of different ages. Differences were reported in the way children of different ages categorize diverse stimuli. Children at age six tended to categorize, on the basis of perceptual cues, into relational groupings. With increasing age, children tended to categorize objects, on the basis of usefulness, into categorical-inferential groupings. By age twelve, most groupings were based on the latter procedure. These findings lend support to Deutsch's work with middle-class children.

Bernstein (1960) found that language is used in a convergent or restricted fashion in lower-class families in contrast to a divergent or elaborated fashion in middle-class families. It was suggested that the restricted use of language by lower-class families may inhibit a child from developing adequate nominative or ready-made labels in identifying his environment.

John (1963) found that lower-class Negro children can label the content in a picture as well as middle-class Negro children, but the middle-class children are better at integrating the labels into a coherent verbal description.

It has been demonstrated that an individual's cognitive style is relatively stable at a given age, changes with development during the elementary school years, and is somewhat dependent upon sex. In addition, some evidence suggests that an individual's preference for a cognitive style may be a function of his experiences. IRCOPPS work reported in a later chapter explores relationships among cognitive styles, speed of information processing, intelligence and achievement.

CHAPTER V

SPEED OF INFORMATION PROCESSING ABILITIES, COGNITIVE STYLE, AND ACHIEVEMENT

John R. Bergan

This study is a factor-analytic investigation of the extent to which speed of information processing skills generalize across content categories and of the relationships among information processing abilities, cognitive style (Sigel--Cognitive Style Test) and achievement (Stanford Achievement Test). Speed of information processing is defined as recognition of stimuli flashed on a screen and followed by interfering stimuli. The four content categories described in the structure of perception model are used in the study: figural, symbolic, behavioral, and semantic. Cognitive style is defined as preference for one of three modes of categorizing: descriptive (classification on the basis of one physical attribute which stimuli have in common), relational (classification based on relationships among stimuli), and inferential (classification based on membership of stimuli in a class not present physically in the stimulus situation).

The following questions were studied:

1. Does speed of information processing ability generalize across content categories?
2. Do speed of information processing skills relate to achievement across content categories?
3. Do cognitive styles exist?
4. Are speed of information processing skills distinct from cognitive styles?
5. Are measures of cognitive style related to achievement?
6. Is the contribution of speed of information processing to

achievement distinct from that of cognitive style to achievement?

The questions dealing with information processing were formulated on the basis of considerations of the structure of perception and perceptual system models.

The structure of perception model provides a basis for classifying similarities and differences among the speed of information processing tests. The tests were designed to differ from each other in content. They are similar in four ways: all involve a recognition type response, all impose a limitation on duration of stimulus presentation, all are visual, and four of the five involve the same stimulus characteristic, form. The similarities among the speed tests suggest that these tests should be significantly correlated. However, it was assumed that content differences would affect the correlations to the extent that it could not be reasonably assumed that these subtests represent parallel forms of the same test.

The perceptual system model provides an explanation as to how content might affect information processing ability. In terms of the model, speed of information processing can be defined as the time necessary to transform and transmit environmental information to the evaluation component and to search the stimulus classification structures within that component in order to identify, label, and categorize the transmitted information.

Content effects on perceptual speed ability arise because of the involvement of stimulus classification structures in speed of information processing. Because each content area requires a different type of stimulus classification structure, content alterations should be expected to influence abilities. Content-associated alterations in stimulus classification structures are assumed to exert this influence through changes in imagery representations, label representations, and concept representations. Changes in any of these types of representation may change the complexity of the classification structure and/or necessitate alterations in search strategy used for the structure. In either case a change in processing time will result.

The introduction of cognitive style measures into the study permits examination of the relationships between perceptual and conceptual categorizing. The perceptual system model indicates that speed of information processing involves categorizing. This study seeks to determine whether or not speed ability is related to categorizing style.

The investigation of relationships between perceptual and conceptual categorizing is complicated by the fact that it cannot be assumed that there are cognitive styles. The scoring procedure used in the past with Sigel's test required that a subject's response to each item in the test be assigned to a style. This requirement created an artificial dependence between the styles. For example, a subject who made a great many categorical inferential responses would automatically make fewer responses in the other two styles. The scoring procedure made it impossible for a subject to attain high scores in all three styles. It artificially produced cognitive styles by producing negative correlations among categories. In effect, the individual was forced to prefer one style over another. In the present study Sigel's items are broken down into three independent tests. On Test 1, credit is given for descriptive responses, on Test 2 for relational responses, and on Test 3 for inferential responses. If Sigel's test items measure distinct cognitive styles, significant negative correlations should be observed among these tests.

METHOD

Subjects and Tests

One hundred thirty-eight children, 68 boys and 70 girls, randomly selected from six 5th-grade classes in the Southwest participated in the study. The subjects were given the Lorge-Thorndike Intelligence Test, the reading and arithmetic sections of the Stanford Achievement Test, the Sigel Cognitive Style Test, and the speed of information processing test. The tests were given in the order in which they are listed. The number of items answered correctly was taken as a subject's score on the achievement test, speed test, and cognitive style measures. On the speed test, some items required more than one answer. To receive credit, it was necessary to answer all parts of an item correctly.

I.Q. and achievement measures were administered by classroom teachers to students in the regular classroom setting. The cognitive style tests were administered in the classroom by an experimenter, with the assistance of the classroom teacher. The speed of information processing test was administered by two experimenters, each of whom proctored four children. Each group of children sat at a table 14 to 17 feet away from the projection screen. Cardboard partitions on the tables separated the children from each other. The projector was placed at a distance of 21 feet from the screen. The experimenters stood behind the children during the test to insure that each child understood and was following directions.

To measure cognitive style, items from the Sigel test were assigned at random to three groups. Each of these three groups was used as a test of one of the three modes of categorizing. To receive credit on

Test 1, a subject had to make a descriptive response. On Test 2 a relational response was required, and on Test 3 an inferential response was needed.

The speed of information processing test requires recognition of stimuli flashed on a screen and followed immediately by masking stimuli. The test is composed of five subtests: F/Se, semantic forms (words), F/Sy, symbolic forms (numbers), F/Fi, figural forms (geometric shapes), F/B, behavioral forms (faces), and Ps/Fi, figural positions (the position of lines in two-dimensional space.)

Each subtest is comprised of 27 items, 9 involving presentation of a single stimulus (e.g. one word, one facial feature, or one number), 9 involving presentation of two stimuli, and 9 involving three stimuli. Stimuli are presented at 6/24, 4/24, and 2/24 of a second, with three trials for each time duration. This series of times is repeated three times for each subtest. Each trial begins with a two-second presentation of a dot. One second after the dot goes off the screen the test stimulus is presented. The masking stimulus follows immediately and lasts for ½ second. There is a five-second interval between trials to allow the subject to respond.

The F/Se (semantic) subtest is composed of single words, two-word, and three-word phrases filmed[1] from Cello-Tak transfer type on poster board. The F/Sy (symbolic) subtest is made up of single digits, double digits, and triple digits, placed 1½ inches apart and is also composed from Cello-Tak transfer type on poster board. The F/Fi figural forms subtest involves recognition of geometric forms presented singly, two, or three at a time. A KOH-I-NOOR Acetograph pen No. 3070-4 on acetate was used to make triangles, diamonds, and trapezoids of varying types for the figural forms subtest. The F/B subtest was made from Cello-Tak transfer type facial cartoon features. The head outline and three facial features, mouth, eyes and eyebrows were used. There are five types of eyes--eyes looking up and right, up and left, down and right, down and left, and small beady eyes looking straight ahead. Mouths are also of five types: big smile, small smile, smile to the right, smile to the left, and frown. Eyebrow variations include both eyebrows raised, right eyebrow raised, left eyebrow raised, both pointing to the center, and both straight across. In the first nine items of the subtest only mouths within head outlines are presented. In the second nine trials, both mouths and eyes are shown, and in the third set of nine items, mouths, eyes and eyebrows are used. Each stimulus in the Ps/Fi (figural positions) subtest is a circle with a radius line in one of eight positions. Each of the first nine items of the subtest require judgments about the position of one radius line. The next nine items involve two circles 1¼ inches apart, each with a radius line. The third set involves three circles 1 inch apart. The circles and lines for the Ps/Fi subtest were filmed from KOH-I-NOOR Acetograph pen No. 3070-4 drawings on acetate. Examples of test stimuli are presented in Figure 7, Page 57.

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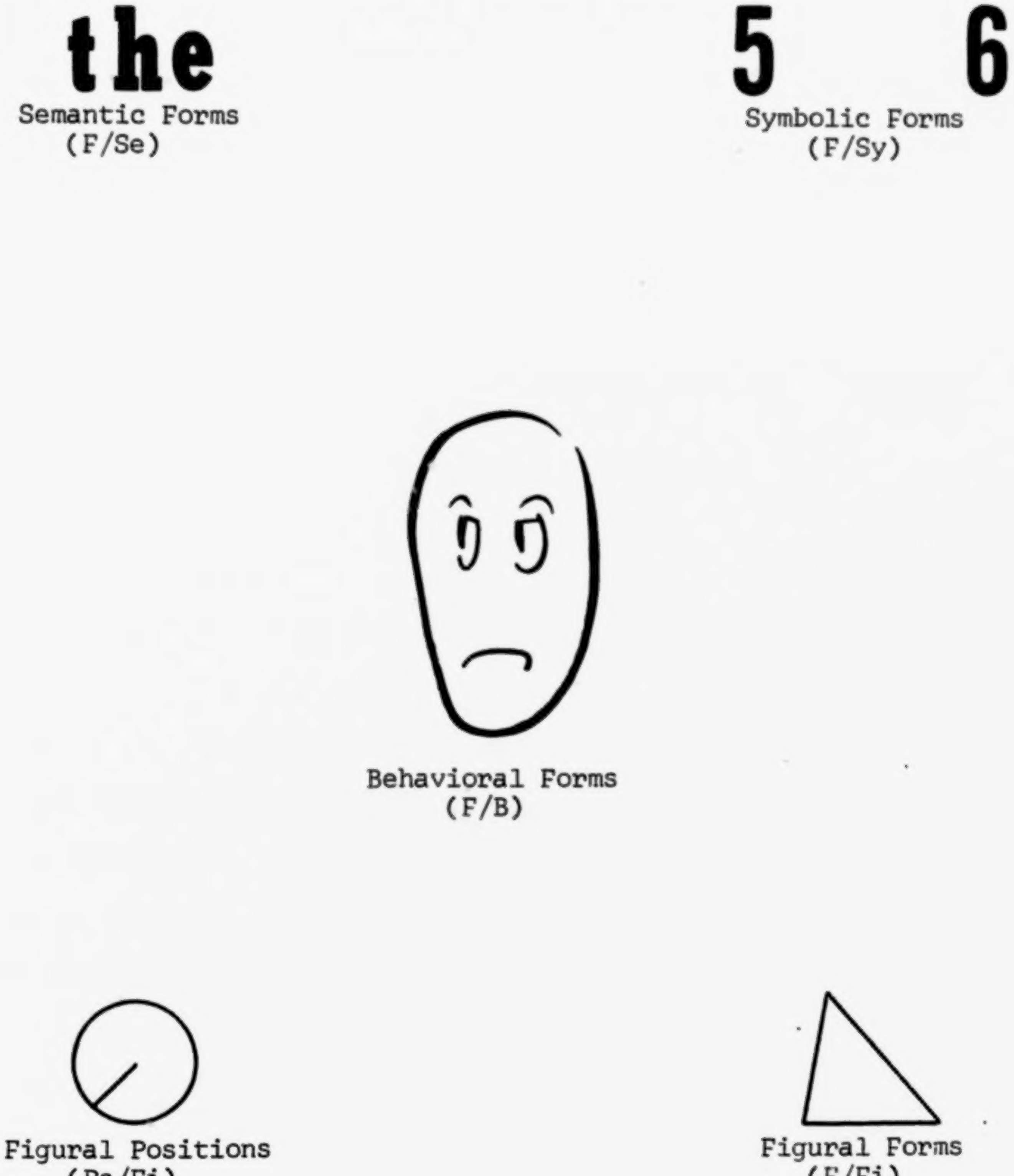
[1] Details of filming and/or prints can be obtained from the Coronado Film Company, 612 North 4th Avenue, Tucson, Arizona.

Multiple choice answer sheets are used for each of the five subtests. The amount of information necessary to correctly identify target stimuli varies among subtests. In the semantic forms subtest, to identify a single word, subjects circle one of five alternatives on their answer sheets. To identify a two-word phrase, subjects select one word from



Semantic Forms
(F/Se)

Symbolic Forms
(F/Sy)

Behavioral Forms
(F/B)

Figural Positions
(Ps/Fi)

Figural Forms
(F/Fi)

Figure 7

each of two columns of five words each. Choices of words in the second or third column are independent of choices in the first column to the extent that all combinations of words between columns represent possible combinations within the language. However, no attempt was made to equate the probability of occurrence within the language of each of the 125 possible combinations of words.

The answer sheets for the symbolic forms subtest are analagous in design to the semantic forms answer sheets. Single digits are identified from single columns with five alternatives, double digits from double columns, and triple digits from triple columns, each with five alternatives.

In the F/Fi (figural forms) subtest, each column on the answer sheet contains two alternatives. Both alternatives are the same type of shape. If the test stimulus is a triangle, the alternatives on the answer sheet will both be triangles. For example, a tall narrow triangle might be paired with a short wide one.

For the first nine trials of the F/B (behavioral forms) subtest, the task is to select the correct mouth from two alternatives. During each of the next nine trials, two types of eyes are combined with two types of mouths to produce four alternatives, representing all possible combinations of mouths and eyes. Then mouths, eyes, and eyebrows are combined, making eight alternatives.

The Ps/Fi (figural positions) subtest used four positions per column, either up, down, right, left, or up and diagonal to the right, up and diagonal to the left, down and diagonal to the right or down and diagonal to the left.

RESULTS

Table 1 presents means and standard deviations for all tests used in the study.

Table 1

MEANS AND STANDARD DEVIATIONS
OF TEST SCORES

Variable Description	Mean	Standard Deviation
Cognitive Style 1	9.464	2.748
Cognitive Style 2	1.790	2.009
Cognitive Style 3	6.928	2.728
Ps/Pt, Fi	10.949	2.316
F/Pt, Sy	14.261	3.252
F/Pt, B	12.819	2.575
F/Pt, Fi	7.609	4.281
F/Pt, Se	14.551	4.658
Verbal IQ	102.616	15.326
Nonverbal IQ	108.319	17.553
Age	124.196	6.000
Sex	1.507	.502
Arith. Achievement	50.217	19.565
Reading Achievement	42.754	17.833

A principle components factor analysis and varimax rotation were performed to determine the relationships among speed of information processing measures, cognitive styles, achievement, and intelligence. Table 2, Page 60, presents the matrix of intercorrelations used in this analysis. From this table it can be seen that measures of cognitive style tend to be negatively related to each other and independent from achievement, intelligence and speed measures. There are positive correlations ranging from .129 to .477 among speed measures. All relations among speed tests and achievement measures are positive and eight of the ten correlations are significant. Moderate relationships exist among speed and intelligence measures.

TABLE 2

MATRIX OF INTERCORRELATIONS

Variable Description	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Cog. Style 1	1.000	-.280	-.214	-.063	.066	.020	.002	-.035	.115	.236	-.029	.130	.074	.144
Cog. Style 2	-.280	1.000	-.308	-.074	-.040	-.185	-.008	-.005	-.104	-.182	.006	-.089	-.077	-.163
Cog. Style 3	-.214	-.308	1.000	.169	.120	.126	.029	.117	.164	.134	.027	-.112	.122	.150
Ps/Pt, Fi	-.063	-.074	.169	1.000	.477	.256	.245	.335	.150	.134	.125	-.128	.229	.254
F/Pt, Sy	.066	-.040	.120	.477	1.000	.170	.129	.416	.378	.252	.066	.084	.385	.454
F/Pt, B	.020	-.185	.126	.256	.170	1.000	.212	.174	.182	.106	.049	-.013	.215	.138
F/Pt, Fi	.002	-.008	.029	.245	.129	.212	1.000	.235	.151	.154	.089	.025	.246	.174
F/Pt, Se	-.035	-.005	.117	.335	.416	.174	.235	1.000	.589	.415	-.105	.108	.661	.531
Verbal IQ	.042	-.110	.159	.662	.708	.511	.454	.773	1.000	.513	-.429	.079	.855	.776
Nonverbal IQ	.236	-.182	.134	.134	.252	.106	.154	.415	.789	1.000	-.430	-.013	.613	.739
Age	-.029	.006	.027	.125	.066	.049	.089	-.105	-.429	-.430	1.000	.112	-.167	-.186
Sex	.130	-.089	-.112	-.128	.084	-.013	.025	.108	.079	-.013	.112	1.000	.125	-.024
Arith Ach.	.074	-.077	.122	.229	.385	.215	.246	.661	.855	.613	-.167	.125	1.000	.778
Reading Ach.	.144	-.163	.150	.254	.454	.138	.174	.531	.776	.739	-.186	-.024	.778	1.000

The principle axis solution given in Table 3, Page 62, indicates that it is possible to describe perceptual speed, achievement, and I.Q. measures in terms of a general factor.

Four rotated factors, which were named achievement, speed of information processing, cognitive style 2 (Relational) and cognitive style 1 (Descriptive) are presented in Table 4, Page 63. The semantic and symbolic speed measures loaded heavily on the achievement factor. Factors 3 and 4 point out negative relationships among measures of cognitive style.

TABLE 3

PRINCIPAL COMPONENTS FACTOR LOADINGS

Variable Description	1	2	3	4	5	6	h^2
Cognitive Style 1	.140	-.499	-.488	.344	-.080	-.343	.749
Cognitive Style 2	-.227	.138	.733	.282	.319	-.138	.807
Cognitive Style 3	.251	.248	-.275	-.665	.012	.413	.813
Ps/Pt, Fi	.481	.578	-.072	-.039	.158	-.227	.649
F/Pt, Sy	.607	.257	-.089	.187	.458	.026	.688
F/Pt, B	.335	.279	-.384	-.077	-.026	-.356	.470
F/Pt, Fi	.353	.358	.007	.222	-.448	-.312	.600
F/Pt, Se	.746	.125	.221	.152	.024	.183	.678
Verbal IQ	.887	-.258	.052	.045	.185	-.123	.907
Nonverbal IQ	.753	-.444	.095	-.142	-.107	-.064	.810
Age	-.209	.565	-.368	.341	.156	.126	.655
Sex	.052	-.121	-.256	.630	-.113	.572	.819
Arith. Achievement	.852	-.120	.141	.110	-.004	.128	.789
Reading Achievement	.862	-.208	.087	-.035	.058	.029	.798

TABLE 4

ROTATED FACTOR LOADINGS

Variable Description	1	2	3	4	5	6	h^2
Cognitive Style 1	.103	-.013	-.060	.842	.117	.110	.749
Cognitive Style 2	-.055	-.025	.827	-.331	.036	-.097	.807
Cognitive Style 3	.125	.144	-.745	-.454	.090	-.086	.813
Ps/Pt, Fi	.205	.736	-.040	-.135	-.171	-.128	.649
F/Pt, Sy	.461	.628	.067	-.071	.200	.180	.688
F/Pt, B	.059	.539	-.255	.253	-.134	-.170	.470
F/Pt, Fi	.150	.338	.044	.188	-.652	-.035	.600
F/Pt, Se	.717	.266	.058	-.171	-.174	.172	.678
Verbal IQ	.911	-.112	-.018	.020	.224	-.067	.959
Nonverbal IQ	.830	-.096	-.155	.224	-.015	-.192	.810
Age	-.442	.499	-.009	-.076	-.033	.451	.655
Sex	.092	-.126	-.023	.138	-.031	.880	.819
Arith. Achievement	.860	.163	-.028	.017	-.097	.114	.789
Reading Achievement	.869	.159	-.100	.076	.012	-.042	.798

DISCUSSION

Loadings for factors 3 and 4 provide some support for Sigel's assertion that there are cognitive styles. Factor 3 indicates that subjects using Style 2 (Relational) did not tend to use Style 3 (Inferential), while Factor 4 shows that subjects using Style 1 (Descriptive) did not tend to use Styles 2 or 3.

The loadings of the speed tests on Factor 2 indicate relationships among speed measures across content categories. However, the moderate magnitudes of the correlations among the speed tests suggest that alterations in content do affect ability. Further investigations are needed to assess the effects of alterations in stimulus characteristics and perceptual tasks on speed of information processing abilities.

The correlations among speed and achievement measures suggest that despite content alterations, speed makes a contribution to achievement. The magnitude of that contribution, however, is related to the content of the speed measures.

The above findings raise four important questions with respect to pupil personnel services: 1) What is the source of content-associated individual differences in speed ability? 2) Can such differences be eliminated? 3) Can speed of information processing ability be taught? 4) If it were taught, would such instruction influence achievement?

Content-associated individual differences are important in Education because they are relevant to the problem of determining relationships among instructional programs in different subject matter fields, and among special education, pre-school, and regular classroom programs.

Pre-school and special education programs make extensive use of figural material. At present it is an open question as to whether or not instruction involving figural material has any relevance for instruction involving semantic material. Information regarding the source and elimination of content-associated individual differences in information processing abilities would provide a starting point for determining cross-content effects of instructional programs.

Questions concerning the extent to which speed of information processing ability can be altered by instruction and the effects of such instruction on achievement offer an approach to extending the usefulness of the concept of ability in pupil personnel work. As mentioned in previous chapters, ability assessment is typically used only in prediction. Knowledge about abilities has not exerted a direct influence on the design of instruction. If it were to be found that speed of information processing ability could be taught and that instruction in this ability altered achievement, a significant step would have been made toward relating evaluation services in pupil personnel work to instructional programs.

CHAPTER VI

SPEED OF INFORMATION PROCESSING IN BEHAVIORALLY-DISORDERED AND NORMAL CHILDREN

John R. Bergan and Rosine Gualdoni

A number of theorists (Allport, 1955; Solley & Murphy, 1960) have advanced the hypothesis that inappropriate behaviors in maladjusted children stem in part from inaccuracies in their perceptions of other people. The present study is based on the assumption that deficiencies in speed of information processing abilities involving semantic and behavioral content are an important source of perceptual inaccuracy in the maladjusted. Interpersonal interaction involves a barrage of semantic and behavioral stimuli which must be processed quickly to insure appropriate behavior on the part of those interacting. An individual slow in processing semantic and behavioral information would be vulnerable to perceptual inaccuracies which could cause him to misinterpret the intent of others.

PROBLEM

This study investigates content-associated differences in speed of information processing abilities between normal and behaviorally disordered children. As in the two previous chapters, speed of information processing is defined as recognition of stimuli flashed on a screen and followed by masking stimuli. Three information processing subtests were used in the study: figural positions, semantic forms, and behavioral forms.

It was hypothesized that behaviorally disordered children would attain lower scores than normal children on tests involving semantic and behavioral content. This hypothesis is derived from the assumption that semantic and behavioral stimulus classification structures used in processing information relevant to inter-personal contacts are deficient in the behaviorally disordered child. The source for these deficiencies is thought to be in the early learning experiences of the child.

METHOD

Subjects

Sixty children, thirty from a special school and thirty from regular classrooms, ranging in age from 10 years 2 months to 14 years 3 months participated in the study. The thirty children from the special school were selected from six classrooms in the school. The school is composed of children from all areas of a city in the Southwest who are considered to be behaviorally disordered. The criteria for this classification are not precisely defined. They include the fact that the child is unable to function in a normal classroom or in a situation where some specialized help can be given. The child is in need of a total specialized environment for learning. Medical, including neurological, problems occur among the children but often are not clearly indicative of the behavioral manifestations seen. Behaviors ranging from withdrawal to acting out are in evidence. Children manifesting overt psychotic behavior are not kept at the school. Family histories vary with the trend being toward problem familial backgrounds. The classes are small, ranging from six to twelve students. The children are grouped by age and in some instances by achievement level.

Thirty children from regular 5th-, 6th-, 7th- and 8th-grade classrooms in the same Southwest city were selected by random procedure from groups matched on age with the behaviorally disordered group.

Tests

The Lorge-Thorndike Intelligence Test, Nonverbal Battery, was administered by an examiner and an assistant in the special classroom in March,

1968. The nonverbal test was used to give maximum advantage to those children with reading problems.

In April, 1968, three subtests of the Speed of Processing Information Test were administered to the thirty behaviorally disordered children. The test was administered to groups of four children at a time with an examiner and two assistants working with each group. One assistant stood behind two children to minimize acting out and to direct the child's attention to the test. The Lorge-Thorndike Nonverbal Intelligence Test was administered in the regular classroom by an examiner in March, 1968. The thirty children from regular classrooms were given the three subtests of the Speed of Processing Information Test in April, 1968. An examiner administered the test to children in groups of eight.

RESULTS

An analysis of covariance (Winer, 1962) was performed to examine relationships among adjustment, age, and speed of information processing abilities. The results of this analysis are summarized in Table 5.

TABLE 5

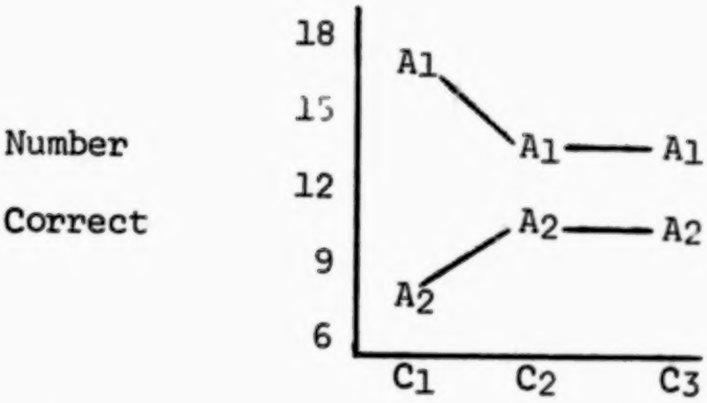
ANALYSIS OF COVARIANCE SUMMARY TABLE

Source	MS	DF	F
A	15.27	1	.8
B	1.82	2	.05
AB	1.38	2	.04
Error Between	995.45	53	
C	55.30	2	2.85
AC	279.01	2	14.30*
BC	35.50	4	.91
ABC	35.39	4	.92
Error Within	1032.80	107	

*P<.01

Factor A is adjustment, Factor B is age, and Factor C is tests of information processing. A significant interaction offering partial support for the hypothesis advanced at the beginning of the study was observed between adjustment and information processing. The diagram of this interaction presented in Figure indicates that behaviorally disordered children differ from normal children in speed of information processing with semantic content, but do not differ from normal children in information processing involving figural or behavioral content. (See Figure 8, Page 71)

FIGURE 8



A_1 = normal group, A_2 = behaviorally disordered group, C_1 = semantic forms, C_2 = figural positions, C_3 = behavioral forms

It is possible that the discrepancies between semantic scores for the two groups result from a tendency for the behaviorally disordered child not to profit from instruction, particularly in the area of reading. This tendency may be related to such factors as not following directions, not attacking learning problems in an organized fashion, not persisting in tasks, and so forth.

Nevertheless, the discrepancy between groups does not imply merely that the behaviorally disordered children could not read the test words. The words in the test were chosen from the 1st- and 2nd-grade levels of the Dolch Sight List. The children in this study could be expected to be able to read the test words. In a previous study (Bergan, 1967) using second-grade children, all of whom could read the words used in the speed of information processing test, individual differences in speed of information processing were observed along with substantial correlations between speed and achievement.

Although stimulus classification structures used in processing semantic material are undoubtedly affected by instruction, the vast repertoire of verbal contacts between people offers an even more significant source influencing the development of such structures. It is assumed that these kinds of contacts played an important role in determining the group differences observed in this investigation.

CHAPTER VII

SPEED OF INFORMATION PROCESSING, FROSTIG MEASURES OF VISUAL PERCEPTION AND ACHIEVEMENT

John R. Bergan and Elaine R. Nicholson

PROBLEM

This study has two purposes: 1) to investigate content-associated intra-individual differences in speed of information processing abilities in first-grade children, and 2) to assess relationships of measures of speed of information processing to visual search abilities measured by the Frostig Developmental Test of Visual Perception and the Metropolitan Reading Readiness Test, to intelligence as measured by the Lorge-Thorndike Intelligence Test, and to achievement as measured by the Stanford Achievement Test.

As in the previous chapters, speed of information processing is defined as recognition of stimuli flashed on a screen and followed by masking stimuli. Four content categories, figural, symbolic, semantic, and behavioral, are used. The study investigates the possibility that speed measures will emerge as a factor separate from visual search abilities and that speed measures will be significantly related to achievement. As in the previous study, it is expected that speed abilities will be moderately correlated, but that content will have some effect on the magnitude of relationships among speed tests.

When the Frostig, Metropolitan Reading Readiness and speed of information processing measures are considered in terms of the Structure of Perception Model, it becomes clear that Frostig and Metropolitan tasks are quite similar to each other, but differ from speed tasks. Most of the tests on the Frostig and Metropolitan involve perceptual tasks which can be categorized under the scanning classification. The subject is required to find something within a complex stimulus situation. Some of these search tasks require a translation of an auditory instruction into a visual representation and then finding a stimulus to match the visual representation. For example, a subject may be asked to find a horse from a series of alternative animals. In other subtests the subject is given a visual standard and must scan a series of complex alternatives to find matches to the standard. Thurstone (1944) grouped activities which seem quite similar to those used in the Frostig and readiness measures into one factor. Goins (1958), as reported in a previous chapter, demonstrated that this factor, strength of closure, was highly related to reading in first-grade children.

Whereas the search activities involved in Metropolitan Readiness and Frostig tests may be characterized by the instruction "Find it", the speed of information processing tests are represented best by the instruction, "Identify it". In the speed tests the subject does not know specifically what he is looking for. When stimuli are flashed on the screen, he must classify them. In the Frostig and Readiness tests, the subject knows what he is looking for: his task is to find it.

The perceptual system model suggests that search activities and identification activities should be quite different. Search activities require the generation of a stimulus classification structure representing the stimulus to be found. The selection component implements strategies for searching the environment for the target stimulus. Such strategies would involve establishing the order in which stimuli would be selected and the cues used in search activities. The evaluation component tests each unit of information transmitted from the environment. In each test, a decision is made as to whether or not that unit matches the representation in the stimulus classification structure.

The stimulus classification structures used in identification activities in most cases are thought to be much more complex than those used in search activities. Whereas search activities usually involve representation of only a single object in a classification structure, identification activities involve the generation of structures representing the many possible stimuli which might be presented.

The selection of information from the environment to be transmitted is a much more complex process in search activities than in identification activities. In search, many stimuli must be considered while in identification typically only a limited number of stimuli are encountered.

Insofar as the activities involved in search and identification are different, it may be assumed that the abilities associated with these activities will also be different. It was on the basis of this assumption that separate search and speed factors were hypothesized.

METHOD

Subjects and Tests

Eighty-seven 1st-grade children, 40 boys and 47 girls, were randomly selected from five 1st-grade classrooms in a suburban school in the Southwest. The children ranged in age from 73 to 91 months.

The Metropolitan Reading Readiness Test was administered by classroom teachers in September, 1967. The Marianne Frostig Developmental Test of Visual Perception was administered over a period of a week in October, 1967, by an experimenter with the assistance of six trained graduate assistants. The Lorge-Thorndike Intelligence Test was administered during February, 1968 by an experimenter in the regular classroom groups with each teacher assisting in her own group. Stanford Achievement Tests were given in the classrooms during the last two weeks in April, 1968. All of the above tests were administered in the classroom settings as group tests.

Speed of Information Processing

The speed test was administered by two experimenters, each of whom proctored two children. Two tables, seating an experimenter with one child on either side, were placed 14 to 17 feet away from the projection screen and to either side of the movie projection table. A cardboard partition, placed directly in front of the experimenter, separated the two children. The projector was placed on a table with the lense opening being 21 feet from the screen. Extreme care was taken by the experimenters to ensure that the children understood and were following the directions.

The speed battery was described in detail in the previous chapter. Only the first 18 items in each subtest were used. A child's scores for each of the Frostig, Metropolitan Reading Readiness, Stanford Achievement, and speed measures were the number of items answered correctly. I.Q.'s were used for the Lorge-Thorndike.

RESULTS

Table 6, Page 80, shows the means and standard deviations for the tests used in this investigation.[1]

To determine relationships among the variables under study, a principle components analysis and varimax rotation were performed (Harmon, 1960). Table 7, Pages 81 and 82, presents the intercorrelation matrix for this analysis.

Intercorrelations among the speed of processing subtests varied from -.038 to .407. Correlations of speed tests with the Frostig test varied from -.058 (F IV Position in Space with Figural Forms) to .426 (F V Spatial Relations with Figural Positions). The Frostig total raw score correlated .534 with total speed of processing scores. Speed of processing information subtest totals correlated .530 with the Metropolitan Reading Readiness total, and .459 with Lorge-Thorndike I.Q. The relationship between speed total and achievement scores ranged from .447 (Paragraph Meaning) to .613 (Arithmetic).

Total Stanford Achievement scores were related .707 with Metropolitan Reading Readiness, .668 with total Frostig, and .635 with total speed.

Table 8, Page 83 presents the principal component factor loadings.

Factor 1 indicates that it would be possible to describe speed, Frostig, Metropolitan Reading Readiness and achievement measures in terms of a general factor. Varimax rotations were carried out and are presented in Table 9, Page 84.

The Kaiser criterion (Harmon, 1960) was used to determine the number of factors rotated. Factor I in Table 9 may be defined as a perception achievement factor. Achievement subtests and total score, semantic, symbolic, figural forms, and figural positions tests, Frostig measures, and the readiness test loaded on this factor. Factor II was named visual search and visual motor coordination. The speed of information processing tests loaded on Factor III. Factor IV can be described as an age factor.

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[1] Chronological age was determined at the time the Lorge-Thorndike was administered (midpoint in the school year, in the month of February).

TABLE 6

MEANS AND STANDARD DEVIATIONS OF TEST SCORES

Variable Description	Mean	Standard Deviation
Ps/Pt, Fi	5.471	2.415
F/Pt,	8.172	2.152
F/Pt, B	9.368	2.237
F/Pt,	8.138	1.541
F/Pt, Se	3.954	2.292
Speed Total	35.103	6.550
Reading Readiness	56.782	16.956
Frostig 1	11.023	3.144
Frostig 2	14.448	4.088
Frostig 3	6.759	3.638
Frostig 4	6.333	1.560
Frostig 5	5.161	1.485
PQ	43.609	10.286
IQ	108.563	12.569
Achievement 1	17.690	6.481
Achievement 2	14.816	7.876
Achievement 3	21.207	5.775
Achievement 4	8.218	5.510
Achievement 5	34.897	9.481
Achievement 6	35.080	11.292
Achievement Total	131.805	39.289
Age	79.483	4.390
Sex	0.540	0.501

Frostig 1: Eye-Motor Coordination
Frostig 2: Figure-Ground
Frostig 3: Form Constancy
Frostig 4: Position in Space
Frostig 5: Spatial Relations

Achievement 1: Word Reading
Achievement 2: Paragraph Meaning
Achievement 3: Vocabulary
Achievement 4: Spelling
Achievement 5: Word Study Skills
Achievement 6: Arithmetic

TABLE 7

MATRIX OF INTERCORRELATIONS

Variable Description	1	2	3	4	5	6	7	8	9	10	11	12
Ps/Pt, Fi	1.000	.400	.082	.079	.407	.689	.415	.381	.421	.271	.257	.426
F/Pt, Sy	.400	1.000	.231	.133	.379	.719	.507	.293	.423	.377	.280	.391
F/Pt, B	.082	.231	1.000	-.038	.155	.493	.134	.045	.095	.055	.161	.108
F/Pt, Fi	.079	.133	-.038	1.000	.212	.369	.121	.074	.125	.112	-.058	.112
F/Pt, Se	.407	.379	.155	.212	1.000	.728	.388	.155	.245	.385	.271	.231
Speed Total	.689	.719	.493	.369	.728	1.000	.530	.324	.442	.404	.323	.430
Reading Read.	.415	.507	.134	.121	.388	.530	1.000	.482	.560	.587	.554	.596
Frostig 1	.381	.293	.045	.074	.155	.324	.482	1.000	.492	.223	.318	.383
Frostig 2	.421	.423	.095	.125	.245	.442	.560	.492	1.000	.380	.414	.574
Frostig 3	.271	.377	.055	.112	.385	.404	.587	.223	.380	1.000	.484	.397
Frostig 4	.257	.280	.161	-.058	.271	.323	.554	.318	.414	.484	1.000	.423
Frostig 5	.426	.391	.108	.112	.231	.430	.596	.383	.574	.397	.423	1.000
PQ	.470	.503	.120	.116	.363	.534	.756	.676	.822	.717	.656	.695
IQ	.248	.428	.261	.161	.286	.459	.405	.244	.274	.264	.307	.342
Achievement 1	.341	.488	.161	.216	.512	.571	.606	.358	.434	.438	.354	.458
Achievement 2	.327	.403	.088	.262	.454	.504	.501	.304	.252	.462	.312	.380
Achievement 3	.288	.363	.147	.033	.468	.447	.628	.321	.354	.440	.324	.464
Achievement 4	.330	.359	.198	.148	.475	.508	.516	.377	.337	.425	.346	.342
Achievement 5	.330	.474	.091	.182	.529	.536	.552	.252	.422	.511	.333	.417
Achievement 6	.396	.561	.167	.204	.508	.613	.710	.363	.552	.541	.486	.598
Ach. Total	.403	.538	.164	.213	.583	.635	.707	.385	.480	.569	.436	.539
Age	.301	.157	-.001	.009	.066	.187	.284	.302	.373	.245	.127	.141
Sex	-.136	-.087	-.044	.053	-.110	-.120	-.120	-.097	-.188	-.049	-.129	-.165

TABLE 7

MATRIX OF INTERCORRELATIONS

(cont'd.)

Variable Description	13	14	15	16	17	18	19	20	21	22	23
Ps/Pt, Fi	.470	.248	.341	.327	.288	.330	.330	.396	.403	.301	-.136
F/Pt, Sy	.503	.428	.488	.403	.363	.359	.474	.561	.538	.157	-.087
F/Pt, B	.120	.261	.161	.088	.147	.198	.091	.167	.164	-.001	-.044
F/Pt, Fi	.116	.161	.216	.262	.033	.148	.182	.204	.213	.009	.053
F/Pt, Se	.363	.286	.512	.454	.468	.475	.529	.508	.583	.066	-.110
Speed Total	.534	.459	.571	.504	.447	.508	.536	.613	.635	.187	-.120
Reading Read.	.756	.405	.606	.501	.628	.516	.552	.710	.707	.284	-.120
Frostig 1	.676	.244	.358	.304	.321	.377	.252	.363	.385	.302	-.097
Frostig 2	.822	.274	.434	.252	.354	.337	.422	.552	.480	.373	-.188
Frostig 3	.717	.264	.438	.462	.440	.425	.511	.541	.569	.245	-.049
Frostig 4	.656	.307	.354	.312	.324	.346	.333	.486	.436	.127	-.129
Frostig 5	.695	.342	.458	.380	.464	.342	.417	.598	.539	.141	-.165
PQ	1.000	.404	.561	.463	.538	.504	.550	.700	.668	.338	-.171
IQ	.404	1.000	.359	.351	.452	.348	.266	.417	.431	-.132	.049
Achievement 1	.561	.359	1.000	.761	.496	.774	.739	.653	.868	.061	-.209
Achievement 2	.463	.351	.761	1.000	.415	.792	.714	.559	.833	.052	-.069
Achievement 3	.538	.452	.496	.415	1.000	.430	.508	.639	.681	.074	-.083
Achievement 4	.504	.348	.774	.792	.430	1.000	.816	.590	.860	.063	-.090
Achievement 5	.550	.266	.739	.714	.508	.816	1.000	.722	.904	.077	-.137
Achievement 6	.700	.417	.653	.559	.639	.590	.722	1.000	.860	.061	.199
Ach. Total	.668	.431	.868	.833	.681	.860	.904	.860	1.000	.079	-.160
Age	.338	-.132	.061	.052	.074	.063	.077	.061	.079	1.000	-.130
Sex	-.171	.049	-.209	-.069	-.083	-.090	-.137	-.199	-.160	-.130	1.000

TABLE 8

PRINCIPAL COMPONENTS FACTOR LOADINGS

Variable Description	1	2	3	4	h^2
Ps/Pt, Fi	.565	-.220	.355	-.315	.594
F/Pt, Sy	.656	.001	.359	.003	.559
F/Pt, B	.236	.117	.591	.305	.511
F/Pt, Fi	.231	.261	.198	-.390	.313
F/Pt, Se	.620	.305	.234	-.186	.567
Speed Total	.776	.127	.579	-.168	.982
Reading Read.	.816	-.213	-.093	.130	.737
Frostig 1	.530	-.422	-.043	-.081	.467
Frostig 2	.657	-.492	.013	-.065	.678
Frostig 3	.658	-.120	-.200	.083	.494
Frostig 4	.570	-.294	-.124	.355	.553
Frostig 5	.668	-.298	-.032	.152	.559
PQ	.850	-.438	-.101	.091	.933
IQ	.520	.134	.307	.472	.604
Achievement 1	.811	.283	-.169	-.104	.777
Achievement 2	.735	.395	-.227	-.144	.768
Achievement 3	.682	.044	-.055	.280	.548
Achievement 4	.761	.360	-.233	-.097	.773
Achievement 5	.798	.319	-.259	-.134	.824
Achievement 6	.857	.051	-.069	.108	.754
Ach. Total	.928	.277	-.201	-.017	.978
Age	.227	-.571	.041	-.492	.621
Sex	-.190	.175	.082	.245	.133

TABLE 9

ROTATED FACTOR LOADINGS

Variable Description	1	2	3	4	h^2
Ps/Pt, Fi	.213	-.188	.454	-.554	.594
F/Pt, Sy	.321	-.309	.563	-.208	.559
F/Pt, B	-.042	-.115	.681	.181	.511
F/Pt, Fi	.358	.265	.249	-.228	.313
F/Pt, Se	.577	-.053	.455	-.155	.567
Speed Total	.456	-.166	.803	-.318	.982
Reading Read.	.404	-.693	.195	-.234	.737
Frostig 1	.127	-.498	.080	-.444	.467
Frostig 2	.146	-.605	.169	-.512	.678
Frostig 3	.404	-.549	.047	-.164	.494
Frostig 4	.140	-.723	.097	-.039	.553
Frostig 5	.228	-.646	.188	-.232	.559
PQ	.302	-.809	.162	-.402	.933
IQ	.201	-.438	.547	.269	.604
Achievement 1	.796	-.321	.163	-.118	.777
Achievement 2	.844	-.209	.094	-.057	.768
Achievement 3	.421	-.557	.237	.062	.548
Achievement 4	.829	-.270	.099	-.048	.773
Achievement 5	.847	-.299	.078	-.107	.824
Achievement 6	.594	-.564	.266	-.111	.754
Ach. Total	.856	-.451	.187	-.083	.978
Age	-.080	-.140	-.028	-.771	.621
Sex	-.111	.083	.064	.331	.133

DISCUSSION

The moderate, but significant, correlations among speed measures add support to the conclusions drawn about content effects on speed abilities in the last chapter. Content alterations reduce the magnitude of correlations among speed measures.

The emergence of separate factors for visual search and speed of information processing measures supports the hypothesis advanced at the beginning of the study that speed of information processing and visual search activities represent separate abilities.

An analysis of the achievement measures used in the investigation indicates that "Find it" and "Identify it" activities, which in this study are assumed to be central to search and speed abilities respectively, abound. The significant correlation between Frostig and achievement is assumed to result from the presence of "Find it" activities in achievement measures. The significant correlation between speed and achievement is assumed to result from the presence of "Identify it" activities presented under time limitations in achievement measures.

The fact that Frostig measures were grouped under a single factor does not preclude the possibility of describing Frostig measures by separate factors. The Frostig measures do not correlate so highly as to make it impossible to construct a battery of tests in such a way that Frostig measures would emerge as separate factors. The educational value of such a procedure would depend on demonstrating that the separate tests made distinct contributions to achievement.

CHAPTER VIII

A COMPUTER ASSISTED PUPIL PERSONNEL SERVICE SYSTEM

John R. Bergan and James A. Dunn

One of the most pressing problems facing education today is that of translating the implications of research into effective educational practice. In the past, it was erroneously assumed that practitioners with little assistance would seek out the information provided by research and would assume responsibility for applying research findings. Recently it has become increasingly clear that if research is to achieve its maximal effect in education, organizations must be created within the educational system to foster interactions between the researcher and the practitioner. The findings of research and the means for applying them must be communicated to the educator in the field, and the questions, concerns, and goals of the educator must be communicated to the researcher.

This chapter describes a method for increasing interaction between research and practice in pupil personnel work. The method is based on the establishment of a Computer Assisted Pupil Personnel Service System (CAPPS) to augment feedback relevant to evaluation and instruction.

The center would assist in feedback in five ways:

1. by generating and periodically updating norms relevant to the needs of the particular schools served by the system;
2. by regularly updating information concerning the validity and reliability of the diagnostic procedures adopted by the participating schools;
3. by predicting performance and monitoring progress of individual children identified for special treatment programs;
4. by carrying on research on psychological processes and using research findings in the development of school relevant diagnostic instruments; and

5. by processing data already available in the schools into information usable for program evaluation.

The center would serve all types of school personnel interested in individualized diagnosis and/or treatment programs. Accordingly, it would provide an opportunity for integrating information about children obtained from a variety of disciplines, and for increasing school personnel awareness of the work of the various types of pupil personnel services.

The basic components of the CAPPS system would be:

a. demonstration schools[2]

b. subscriber schools

c. the CAPPS Center

d. university training programs, and

e. the scientific and professional community at large.

Figure 9, Page 88, illustrates the transmission of information among these components. Arrows indicate transmission of information to and from the Center.

The involvement of several schools within the system would allow each school to benefit not only from the information which it has generated, but also from the data provided by other schools, and the constant flow of input to the Center would make it possible frequently to update output from the Center.

The Center may be conceived as a man-machine subsystem composed of three components: a data acquisition component, a data processing

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[2] Demonstration schools are schools selected to participate in the CAPPS demonstration system. In addition to the consultation and field services which would be provided to these school systems, services would also be provided to the extent of manpower and computer availability to subscriber systems which would underwrite the expense of the services they received.

INFORMATION FLOW

IN

THE CAPPS SYSTEM

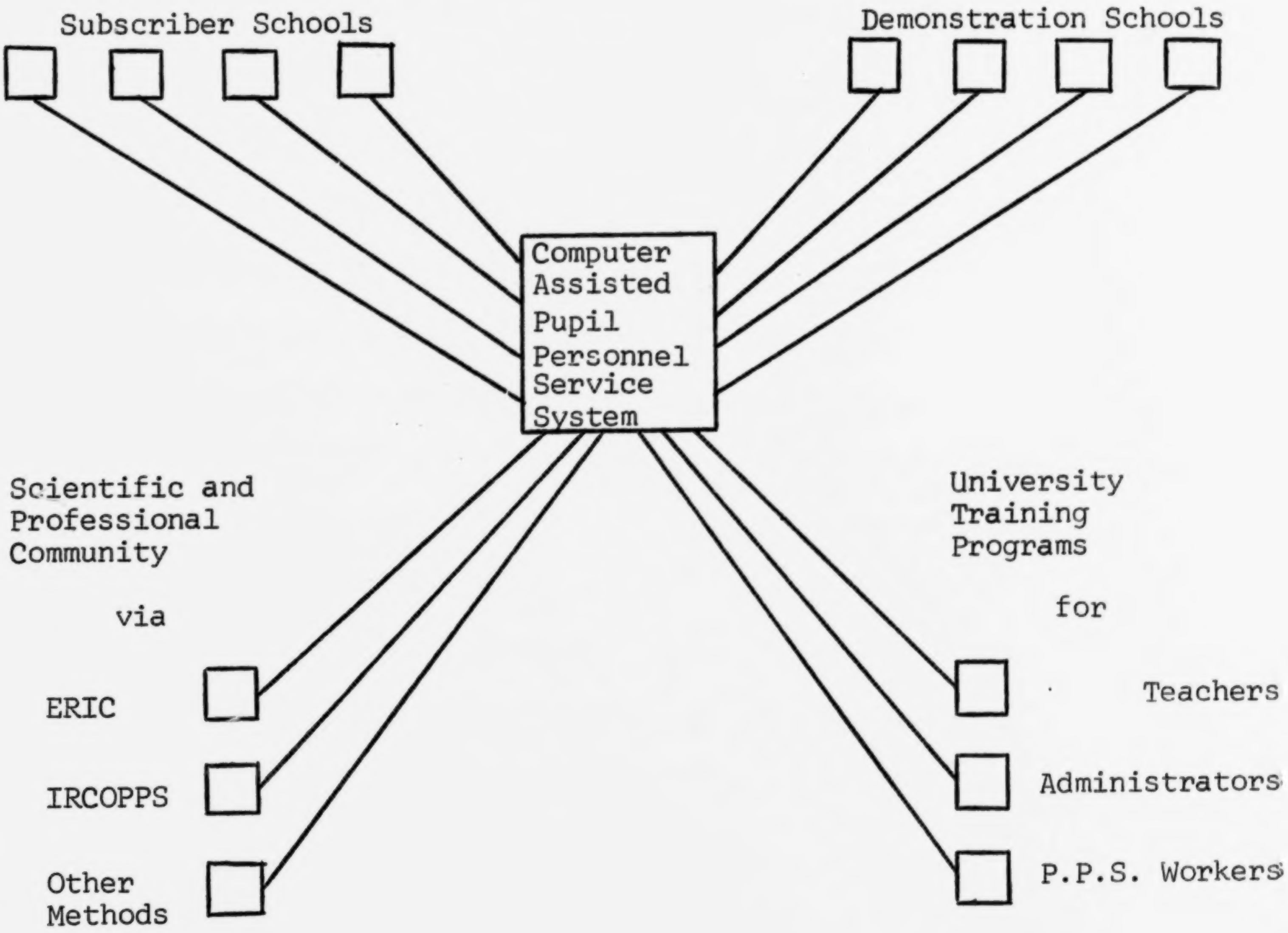
Subscriber Schools
Demonstration Schools
Computer Assisted Pupil Personnel Service System
Scientific and Professional Community
via
ERIC
IRCOPPS
Other Methods
University Training Programs
for
Teachers
Administrators
P.P.S. Workers

Figure 9

component, and an information dissemination component. Figure 10, Page 90 illustrates the functions of these components.

Data Acquisition

The data acquisition component would provide the first point of interaction between the Center and the participating school districts. Procedures for the transmission of data and requests from the participating schools to the Center would be devised. Participating schools would indicate the type and format of information they wished to receive from the Center, and the Center would coordinate the requests of the various school districts to maximize the sharing of information. Figure 10, Page 90, illustrates the process of data acquisition in the system. To implement this process, consultation would be provided for participating school districts. Consultants would 1) work with pupil personnel workers in establishing measurable goals for assessing the effectiveness of their services on the behavior of children; 2) assist pupil personnel workers in determining what information would be submitted to the Center; and 3) develop uniform procedures for collecting and formating input to the Center.

Data Processing

The data processing component would provide the vehicle for information sharing. It would transform the raw incoming data from all participating schools into coordinated, usable information. Figure 10 (Page 90) lists the kinds of information which would be provided.

Norms. In order to adequately interpret the results of diagnostic tests for the individual child, it is essential that the child be described in terms of a suitable reference group. Norms currently

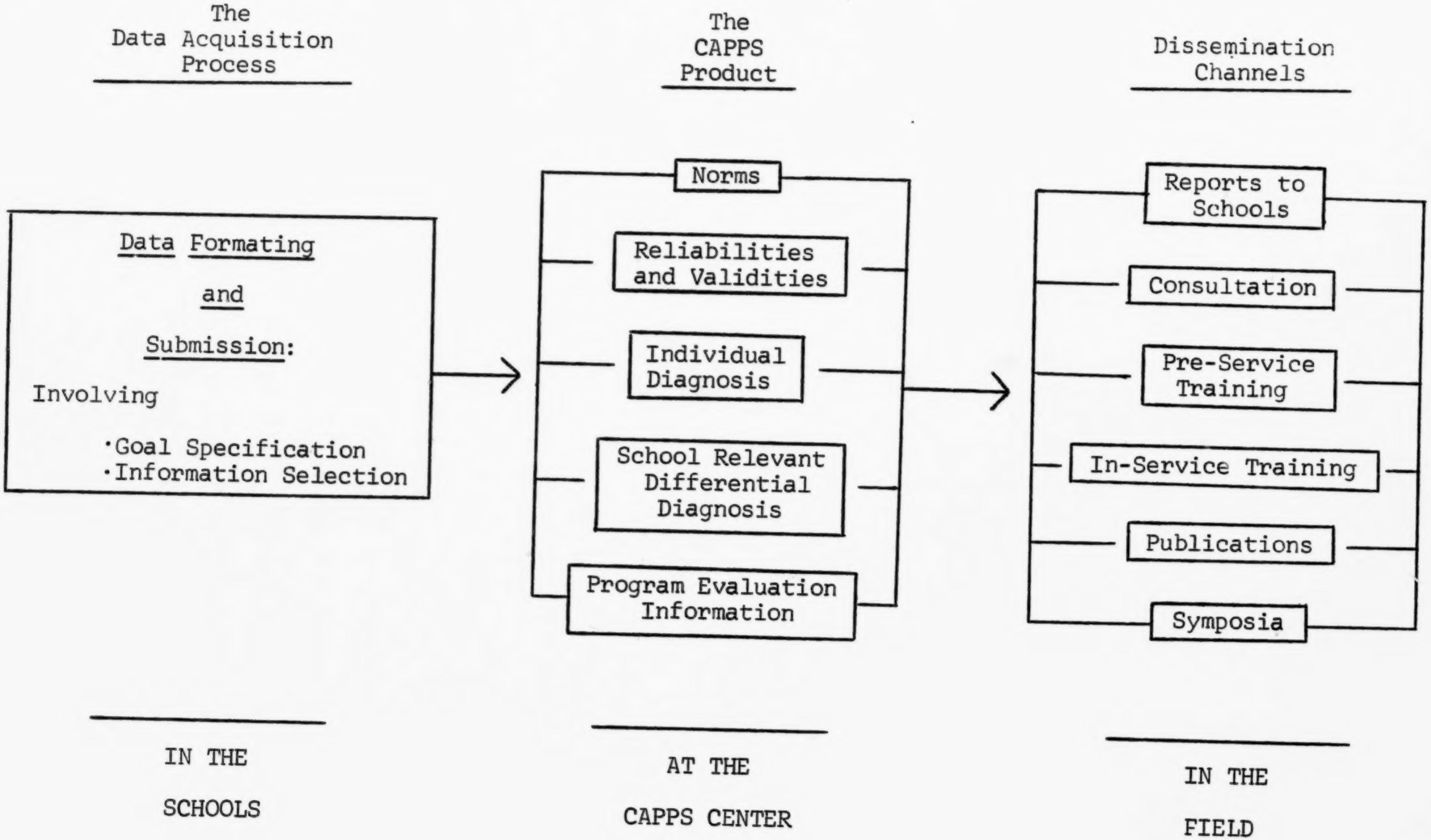
The Data Acquisition Process
Data Formating and Submission:
Involving
·Goal Specification
·Information Selection
The CAPPS Product
Norms
Reliabilities and Validities
Individual Diagnosis
School Relevant Differential Diagnosis
Program Evaluation Information
Dissemination Channels
Reports to Schools
Consultation
Pre-Service Training
In-Service Training
Publications
Symposia
IN THE SCHOOLS
AT THE CAPPS CENTER
IN THE FIELD

Figure 10

available for many of the most widely used diagnostic procedures in pupil personnel work are outdated and often inappropriate for the populations to which they are being applied. The CAPPS system would generate, on a regular updating basis, local norms and norms describing a child with respect to regional, ethnic, and socio-cultural reference groups. Participating schools would be selected to represent Southern, Midwestern, Farwestern, and Eastern regions of the country; Negro, Mexican-American, Indian, and Caucasian ethnic groups; and rural and urban populations.

Validity and Reliability. The maximization of the predictive effectiveness of diagnostic procedures within a given school setting requires a comparison of validity for that setting with validity in other settings. In establishing the validity of a diagnostic procedure, an assumption is made that insofar as the procedure has been demonstrated to be valid in one situation its validity can be assumed for other similar situations. Although this assumption is theoretically legitimate, it is difficult to apply. The characteristics of the populations of individual school districts vary widely; and furthermore are constantly changing. Frequently because no other alternative is possible, tests are used with groups not at all similar to the original norming and validation groups. Furthermore, assumptions about validity often are based on standardization norms generated a decade or more ago. Thus current validity may be subject to question.

Finally, the magnitude of validity may vary from setting to setting. Intelligence test "A" may be a better predictor of academic success than intelligence test "B" in one school district but not in another. Ironically, the information ordinarily necessary to conduct local timely validity studies is often available in regular school records. But schools do not have the necessary manpower or facilities to use the information which they already have, nor do they have an effective mechanism for sharing information with other districts. An evaluation system involving several types of school districts could provide a broad and continuously updated picture of the validity of typical school diagnostic procedures in a variety of settings.

Reliability, like validity, can vary from setting to setting. It is important for school personnel to know that the tests which they administer are reliable for the group with which they are working. The proposed CAPPS system would provide this information.

School Relevant Diagnostic Procedures. School relevant diagnosis is the assessment of abilities, attitudes and feelings which have been shown to be related to school behavior. The concept of school relevant diagnosis is based on the assumption that the validity of measures of psychological processes is enhanced by defining such processes in terms of the situations in which they are used. IRCOPPS work done at the University of Michigan Midwest Regional Center during the past four years and more recently at the University of Arizona and Harvard University has indicated the value of this assumption in education. All of the work on school anxiety, cognitive processes, and speed of information processing has as its focus the description and measurement of psychological processes as they affect performance in educational settings.

The development of school relevant diagnostic procedures requires the analysis of major curricular patterns (e.g. reading instruction and mathematics instruction) to identify the specific abilities, attitudes and feelings which underlie mastery of curriculum content and to ascertain the abilities, attitudes and feelings which are taught within the curricular structure. In addition research must be carried on to measure psychological processes relevant to education and to establish effective means for enhancing the functioning of such processes in education. IRCOPPS work done during the past five years provides a beginning with respect to accomplishing this task. IRCOPPS findings are ready to be applied in educational settings. Now they must be combined with practice. The effort to devise new theories, attain new knowledge, and establish new techniques for improving pupil personnel services must continue and must be integrated with the efforts of the practitioner. The CAPPS system would provide an effective means for achieving this end.

Program Evaluation Information. There is a great deal of information available in the schools (achievement test records, cumulative records, results of psychological testing, etc.) which could be used to discover effective diagnostic and treatment procedures in pupil personnel work. For example, it is possible that within a given school district children receiving services in some pupil personnel program experience large changes in I.Q. In the absence of any systematic analysis of I.Q. data within the school district, these changes would go unnoticed. Campbell and Stanley (Gage, 1963) have delineated a series of "quasi experimental" designes which enable the researcher to effectively use data in situations in which a rigorous experimental design cannot be employed. The information processing component would establish computer programs to channel incoming information into appropriate "quasi experimental" designs, and thereby provide a continuous and nearly automatic search for effective procedures in pupil personnel work.

Diagnosis and Prognosis. A major aspect of pupil personnel work is the specification and implementation of educational procedures designed to influence children's behavior. Too often the pupil personnel worker is not systematically advised of the results of his services. For example, the school psychologist may recommend counseling for a number of children, special education for a number of others, institutional placement for others, and so on. If he is to know the results of his recommendations, he is faced with the impossible task of tracking down and recording the progress of each of the children whom he has served. Similarly, the school social worker, after he terminates a case is apt never to know again what has become of his charges. The center would provide follow-up services to the cooperating school districts. When requested, assistance would be given in the development of special educational plans for specific children and in the periodic monitoring of progress through the planned pupil personnel service worker for use in further educational planning and in reporting to parents, teachers, and others responsible for the welfare of the child.

Information Dissemination

The center would provide information to participating schools, university training programs and the scientific and professional community at large. Figure 10 (Page 90) lists the six channels of communication which would be used.

Reports to schools. Periodic reports would be issued to schools providing the types of information described in the discussion of the information processing component. In addition, schools would have access to information about individual children on demand. Reports involving numerical data would have the data presented in a verbal mode to facilitate the recipient's accurate interpretation of the technical results.

Consultation. Informal consultation would also be provided to aid in the improvement of reports, to assist schools in maximizing the usefulness of information in reports, and to explore with school personnel new ways of effectively communicating information to schools.

Pre-service Training. Seminars and internship experiences would be provided for prospective pupil personnel workers in university training programs. These experiences would include study of computer use in diagnostic and treatment procedures, examination of the computer as a communications tool in pupil personnel services and work in pupil personnel research.

In-service Training. Pupil personnel service workers in participating schools would receive interdisciplinary in-service training and supervision in cooperative pupil personnel work. In addition pupil personnel service workers, their supervisors and administrators would be given the opportunity to obtain intensive familiarization with the potential utility that can be made of cooperative computerized diagnostic services.

Publications. Periodic publications describing center activities would be prepared by the center. In addition, center staff would publish material in scientific and professional journals and would use the ERIC and IRCOPPS channels as means of reaching the professional public.

Symposia. The center would sponsor and host annual symposia on educational technology in pupil personnel services. These symposia would be designed to stimulate new developments in pupil personnel work by providing an opportunity for noted professionals in pupil personnel services and educational technology to interact. Papers and reactions presented at symposia would be edited by center staff and published.

CAPPS and The Educational System

The CAPPS center has been described as a component within an educational system involving elementary and secondary schools, the University and the scientific and professional community. The organizations described as components of this system in the past have developed along relatively independent lines. There have been no mechanisms to enable them to function as a system and a needless and costly lack of coordination of effort has been the result.

One of the challenges facing education today is that of devising ways to increase the effectiveness of educational organizations by enabling them to function as components within broadly defined educational systems. The CAPPS system represents one effort in this direction.

CHAPTER IX

ANXIETY RESEARCH

James A. Dunn and John R. Bergan

The Three Major Theoretical Approaches to Anxiety Research

Three major theoretical approaches have been employed in children's anxiety research to date: the learning theory approach, the psychoanalytic approach, and the situational stress approach. In the first, anxiety is seen as a chronic drive related affect state. This was the point of view of the Iowa group (Spence and Spence, 1966). According to this point of view, an individual's anxiety state is a relatively stable state. The Manifest Anxiety Scale, a questionnaire instrument based on items derived from the Minnesota Multi-phasic Inventory, was developed by Taylor (1953) to measure that state. In 1956, Castenada, McCandless and Palermo modified the MAS for use with children.

The Children's Manifest Test Anxiety Scale (Castenada, _et al_., 1956) contains 53 items including an 11-point Lie Scale, selected from the MAS on an _a priori_ basis, as being most appropriate for children. Pooled estimates of the reliability of the 53 item anxiety scale were .83 (Holloway, 1959).

Psychoanalytic theory sees anxiety as a consequence of intra-psychic conflict. The emotional strain on the individual resulting from this conflict is believed to cause an energy drain which impedes the individual's ability to function effectively. It was this point of view that was adopted by Sarason, Davidson, Lighthall, Waite, and Ruebush (1960). Unlike Taylor, who was interested in general anxiety, Sarason _et al_. focused attention on anxiety precipitated by a specific situation, namely the testing or evaluation situation. Accordingly, he developed the Test Anxiety Scale for Children (Sarason, et al., 1958) . The TASC differs from such general anxiety scales as the MAS and the CMAS in that it focuses on a specific, rather than a broad, class of situations. The TASC is a 30-item scale scored on a yes-no basis. Sarason et al. reported validity coefficients of -.23 to -.30 with IQ and -.17 to -.31 with academic achievement. Test-retest reliabilities were in the mid .60's.

The situational-stress approach to the study of anxiety is less clearly identified with a specific theory such as Hullian or psychoanalytic theory. Rather it rests on a somewhat broader view which holds human behavior to be impeded by distracting and disruptive or disorienting influences. These distractors, or stressors, include threatening instructions; electric shock; exposure to "painful" influences, such as pictures of severe automobile accidents; attention distractors, such as sudden loud noises; and the like (For example, see Deese, 1962, and Lazarus and Opton, 1966).

Response Bias and Questionnaire Measures of Anxiety

Research on response bias can be divided into two categories, one dealing with attempts to identify specific response sets causing bias and the other concerned with eliminating bias. In recent years, most research has centered around the identification of "acquiescence," "social desirability," and "defensiveness," in questionnaire protocols.

A great deal of research has been done to establish the fact that acquiescence, social desirability and defensiveness can be separated from each other (Hand, 1964; Foster and Grigg, 1963; Bendig, 1962; Hand and Brazzell, 1965; Rosenwald, 1961; Ruebush, 1963). Findings indicate that separate response sets do exist. The kinds of items which may eliminate one type of response set, however, sometimes exaggerates others (Quinn and Lichenstein, 1965).

The fact that multiple response sets do exist, and that the types of questionnaire items employed affect response sets pose serious problems with respect to the removal of response bias from questionnaire scores. The elimination of specific response sets does not guarantee the removal of all bias: only bias relevant to that response set. Furthermore, attempts to eliminate a particular response set by altering the type of items employed may cause another response set to come to the fore.

In addition to the fact that a variety of response sets exists, it is important to note that there are both inter-individual and inter-group differences in the extent to which sets are used. Christin and Lindauer (1963), for example, found acquiescence to be greater in children than adults and greater in more poorly educated subjects than in better educated subjects. If this is so, than maximal bias could be expected to be present in questionnaire scores of culturally disadvantaged children.

Attempts to remove bias have centered around the establishment of special scoring procedures involving the use of response set scales and the differential weighting of items on the basis of their correlation with a criterion. Neither procedure has been particularly effective (Guilford, 1954; Hand & Brazell, 1965).

Increases in the ability to define a criterion as a result of applying special scoring procedures on differential weighting of items have typically been minimal. There are a number of possible reasons for this. Differential item weighting does not increase the proportion of score variance in an item. Thus, it cannot increase the predictive power of an item, but only minimize the contributions of items with low validity. The influence of response bias typically may operate to such an extent that minimizing the effects of low validity items is not sufficient to materially increase predictive power. Special scoring procedures generally eliminate only a single type of response set. In questionnaire research many types of response sets can be operative simultaneously. In addition, special scoring procedures do not eliminate variability bias.

The crucial need outlined by the lack of increase in predictive power achieved by existing methods is for a procedure which will demonstrate the removal of bias by materially enhancing validity. The school anxiety scoring procedure described in a subsequent chapter is an attempt to meet this need.

Behavioral Observation Techniques in Anxiety Measurement

Teachers apparently have considerable difficulty recognizing the behavioral cues of anxiety in normal children. Sarason _et_ _al_. (1958) asked teachers to rate their pupils on 17 items derived from the TASC. The teachers produced a wide range of response patterns: some considered virtually all of their students to be devoid of anxiety, some grouped their pupils very closely around the midpoint of the scale, some used the entire scale range, etc.

There is ample evidence, as far back as Wickman (1928), however, that teachers can recognize gross pathological syndromes. Consequently, it would be reasonable to assume that, given an adequate taxonomy of behavior, teachers could become fairly perceptive of subtle anxiety changes in normal children.

Technological advances in the last decade have made the systematic exploration of behavioral mannerisms much more possible. In the past, observation of live behavior was beset with problems of reliability. Recently, however, a number of investigators have been experimenting with the use of available light television recording equipment in collecting behavior records. In 1960 Bantel demonstrated the effectiveness of the videotape recording procedure in collecting permanent records of spontaneous normal classroom behavior. These techniques were later employed by Kounin (1962) in a study for the National Institute of Mental Health (M-4221) dealing with the classroom management of emotionally disturbed children. Walz, at the University of Michigan, has used the videotape procedure for training school counselors, and the Michigan IRCOPPS Midwest Research Center, directed by James A. Dunn, has used the closed-circuit videotape procedure for analyzing teacher-pupil interaction in the classroom.

Work on school anxiety presented in this report and in IRCOPPS reports from the Midwest Regional Center make use of the questionnaire approach to the measurement of anxiety. Future efforts at anxiety measurement planned by the authors include an attempt to link behavioral observation techniques to questionnaire measurement.

CHAPTER X

A SPECIAL SCORING PROCEDURE FOR MINIMIZING RESPONSE BIAS ON THE SCHOOL ANXIETY QUESTIONNAIRE[3]

John R. Bergan

This chapter has two aims: to present a rationale and procedure for minimizing the effects of response bias on questionnaire scores and to discuss the effectiveness of the bias minimization procedure with respect to increasing questionnaire validity.

A RATIONALE AND PROCEDURE FOR BIAS MINIMIZATION

The Nature of Response Bias

Response bias with respect to a questionnaire is consistency in an individual's reports which does not reflect the characteristic that the questionnaire is designed to measure. The amount and direction of bias is assumed to vary across individuals, but to be stable within individuals.

Two types of response bias can be distinguished, additive bias and multiplicative bias. Additive bias is thought to influence an individual's item responses and consequently his response mean by adding a constant to each item true score. For example, some subjects may rate themselves higher on the average than their true scores.

Additive bias may and in most instances probably does derive from the influence of a number of identifiable response sets. Indeed a great deal of research in recent years has been done to establish the fact that response sets, particularly acquiescence, social desirability and defensiveness, do exist in questionnaire responses and can be separated from each other (Hand, 1964; Foster & Grigg, 1963; Bendig, 1962; Hand & Brazzell, 1965; Rosenwald, 1961; and Ruebush, 1963).

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[3] Presented at American Psychological Association Symposium on "Anxiety and School Behavior," (Janet Taylor Spence, Chairman) Washington, September 1967. Appears in Psychology in the Schools, Vol. V, No. 3, 210-216, July 1968.

Bias may affect an individual's response variability as well as his response mean. For instance, some persons consistently may tend to use more extreme choices than their true scores. Bias affecting variability influences an individual's raw score by combining multiplicatively with his true score and thus may be called multiplicative bias.

As is the case with additive bias, multiplicative bias may be composed of components. There may be specific variability patterns corresponding to the response sets associated with additive effects. Investigations of this possibility have, as yet, not been reported in the literature.

The following equation presents the manner in which additive and multiplicative bias are assumed to affect an individual's response to a questionnaire item.

$$X_i = T_i \times M_b + A_b + E$$

X_i represents the individual's response to the item, T_i is his true score on the item, M_b, multiplicative bias, A_b, additive bias, and E, random error.

A Procedure for Removing Bias

An individual's true score for an item may be expressed as:

$$T_i = \frac{X_i - A_b - E}{M_b}$$

and the mean of his true scores ($\overline{T}$) over a series of items as:

$$\overline{T} = \Sigma \left[\frac{X_i - A_b}{M_b} \right] \div N$$

where N is the number of items in the series.

The last equation presents a framework for removing bias from questionnaire scales providing that values can be determined for A_b and M_b. These values can be obtained by producing conditions under which for all persons true score means can be assumed to be equal and true score standard deviations can be assumed to be equal. If under such conditions raw score means and standard deviations are not equal, response bias is present. The constants which must be applied to an individual's raw score mean and standard deviation to equate them with the true score means and standard deviations of other individual's scores can be taken as the values of A_b and M_b for that person. If each person's distribution of true scores is converted to a distribution of z scores, the values representing A_b and M_b for each individual are his raw score mean and standard deviation.

Bias Minimization and Assumptions About Anxiety

Creating a set of conditions in which both true score means and true score standard deviations can be assumed to be at least approximately equal is dependent upon the kinds of assumptions which can be made about the trait or condition being measured, in this case anxiety.

The bias minimization procedure for the SAQ is based on two assumptions about anxiety. The first is that anxiety is an experience common to everyone. The second is that there are individual differences among persons in the kinds of situations which will elicit anxiety.

The above assumptions suggest that if persons are placed in a series of similar and potentially stressful situations individual differences in overall anxiety reactions for all the situations in the series will be maximized. Persons who tend to react with anxiety in the first situation will do so again in the rest of the situations; persons who do not react with anxiety in the initial situation will tend not to exhibit anxiety in the remaining situations.

If, on the other hand, persons are exposed to a series of situations which represent a wide variety of types of potentially stressful conditions, individual differences in anxiety reactions will be minimized. An anxiety reaction in one situation in the series will not necessarily imply similar reactions in the other situations. Differences among people will tend to cancel. An individual's true score mean for questionnaire responses dealing with such a series of situations should tend to be equal to the true score mean of other persons. True score standard deviations should tend to be equal as well. These are the necessary conditions for determining values for A_b and M_b.

The Response Bias Adjustment Scale

To create conditions in which equal true score means and standard deviations for all subjects could be assumed to be equal, a response bias adjustment scale (RBAS) was constructed as part of the development of the SAQ.[4] The RBAS was composed of items representing a wide variety of school situations potentially capable of eliciting anxiety reactions. The items in the scale have low intercorrelations indicating a lack of individual consistency in responsed to the scale. It was assumed that means and standard deviations on the scale for all subjects should be equal and that differences among people with respect to these values indicated response bias.

A given subject's RBAS mean and standard deviation were taken as the values for that subject of A_b and M_b respectively. These values could be and were applied to the item scores in the various SAQ subscales to minimize response bias.

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[4] For further information on the SAQ (School Anxiety Questionnaire), see Dunn, J. A. The Theoretical Rationale Underlying the Development of the School Anxiety Questionnaire, Psych. in the Schools, Vol. V, No. 3, July, 1968.

THE EFFECTIVENESS OF THE BIAS MINIMIZATION PROCEDURE FOR INCREASING QUESTIONNAIRE VALIDITY

The principal value of any procedure for minimizing response bias lies in the effects of the procedure on validity. The enhancement of the validity of an instrument to which a bias minimization procedure is applied not only increases the usefulness of the instrument, but also provides a most important indication of the validity of the procedure itself. The usefulness and validity of the bias minimization procedure applied to the SAQ, then, is related to the degree to which it improves the predictive power of the instrument. A number of exploratory studies have suggested that the procedure is useful.

Forerunners of the present technique were used to measure relationships between visual imagery and reading achievement ($r = .44$) (Bergan, 1966) and relationships between auditory imagery and skill in pitch identification ($r = .55$ for men; .40 for women) (Bergan, 1967). In a study by Schelkun and Dunn (1967) the RBAS scoring technique produced failure anxiety correlations with academic achievement measures in the negative .30's and negative .40's.

None of the studies to date was designed to assess the ability of the RBAS procedure to increase validity. I shall comment in detail on a study which provides data bearing on this question.

The study is an examination of the effects of the bias minimization procedure for elementary school children on concurrent validity coefficients involving three subscales of the SAQ and academic achievement as measured by the Iowa Test of Basic Skills. The three subscales chosen were those assumed to be negatively related to achievement, i.e. the report card anxiety subscale, the failure anxiety subscale, and the test anxiety subscale. It was hypothesized that in a significant majority of instances the validity coefficients involving achievement and adjusted SAQ subscale scores would more closely approximate hypothesized anxiety-achievement relationships than corresponding coefficients involving raw SAQ subscale scores and achievement.

METHOD

Four randomly selected samples of children: 60 third graders, 64 fourth graders, 81 fifth graders, and 81 sixth graders participated in the study. The children all came from a large middle-class suburban school district. The mean and standard deviation for age, in months, at each grade level were: Mean 3rd grade 99.92, 4th grade 111.29, 5th grade 125.81, 6th grade 136.40; Standard Deviation 3rd grade 3.96, 4th grade 5.26, 5th grade 6.18, 6th grade 5.46.

Both the achievement test and the anxiety test were administered to the children in their regular classrooms. In all cases, the achievement tests were administered approximately two weeks prior to the SAQ. The Iowa Test of Basic Skills was given by the classroom teachers according to manual instructions. An achievement quotient was obtained for each subject by dividing his grade placement score for the total test by his age. Tape recorded instructions were used for the SAQ. A subject received two scores, a raw score and an adjusted score, for each of the three SAQ subscales used in the study. The raw score for a subscale was the mean of the item responses for that subscale. The adjusted score was the mean of the adjusted item responses for that subscale. Item adjustment was accomplished by subtracting the RBAS mean from each item and dividing the result by the RBAS standard deviation.

RESULTS

Table10, Page110, presents means and standard deviations for the RBAS, for adjusted and raw SAQ subscale scores and for achievement.

Table11, Page111, presents two types of partial correlations. The first type involves correlations between each of the SAQ adjusted subscale scores and achievement with the effects of the other SAQ adjusted subscale scores partialled out. The second type presents the corresponding raw score partial correlations with achievement.

The partial correlations were computed in order to make it possible to consider both the adjusted validity coefficients and raw validity coefficients as random variables.

The sign test was used to test the hypothesis that a majority of the partial correlations involving SAQ adjusted scores would be better predictors than corresponding correlations involving SAQ raw scores. As was the case without partialling, in all but one of the pairs, the difference between adjusted and raw coefficients is in the predicted direction ($p = .003$). In all seven of the pairs involving significant coefficients, differences are in the predicted direction ($p = .006$).

The impact of response bias minimization on validity is perhaps most clearly shown below in the multiple correlations between anxiety subscale scores and achievement for each grade level. For all grades the multiple correlations obtained using adjusted SAQ subscale scores are higher than those obtained using raw SAQ subscale scores and three of the four are of relatively substantial magnitude: Raw Scores 3rd grade .39, 4th grade .15, 5th grade .37, 6th grade .23; Adjusted Scores 3rd grade .42, 4th grade .26, 5th grade .46, 6th grade .38. Both raw score and adjusted score correlations represent the combined relationships between all three anxiety subscales and achievement.

TABLE 10

MEANS AND STANDARD DEVIATIONS FOR ANXIETY SUBSCALE SCORES AND ACHIEVEMENT FOR EACH GRADE LEVEL

Grade	RBAS		RC-R		RC-A		FA-R		FA-A		TA-R		TA-A		AQ	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
3	6.77	.52	6.70	.85	50.76	4.11	7.78	.70	55.67	3.53	6.48	.80	47.39	3.99	1.04	26.00
4	6.71	.87	6.72	1.26	50.42	5.41	7.22	.96	53.26	3.37	6.65	.82	48.95	4.74	1.00	20.18
5	6.55	.66	6.40	.80	48.33	4.69	7.12	.81	53.60	4.16	6.29	.72	47.46	3.48	1.01	22.00
6	6.63	.50	6.60	.85	49.87	5.54	6.99	.69	52.65	3.39	6.20	.65	46.95	3.29	1.00	18.50

RC = Report Card Anxiety
FA = Failure Anxiety
TA = Test Anxiety

R = Raw Score
A = Adjusted Score
AQ = Achievement Quotient

TABLE 11

PARTIAL CORRELATIONS BETWEEN ANXIETY SUBSCALE SCORES AND ACHIEVEMENT FOR EACH GRADE LEVEL

		3rd Grade	4th Grade	5th Grade	6th Grade
RA	Raw Score	.13	-.15	-.31	-.09
	Adjusted Score	-.07	-.25*	-.41*	-.11
FA	Raw Score	-.10	.06	-.03	-.05
	Adjusted Score	.11	-.07	-.20	-.19
TA	Raw Score	-.37*	.06	.19	-.07
	Adjusted Score	-.42*	.02	.01	-.22*

*(P .05)

Note.--Each raw score correlation represents the relationship between a raw anxiety subscale score and achievement with the effects of the other raw anxiety subscales partialled out. Similarly, each adjusted score correlation represents the relationship between an adjusted subscale score and achievement with the effects of the other adjusted subscales partialled out.

DISCUSSION

Though the results of this study are generally supportive of the usefulness of the bias adjustment procedure, they raise some questions. It is important to know why validity coefficients for the 4th grade are low and why there is so little difference between the adjusted and raw multiple correlations for the 3rd grade.

The low validity coefficients for the 4th grade point to a major problem in school anxiety research. It is possible that one or more of the teachers in the 4th grade handled classes in such a way as to minimize stress. This state of affairs could result in a reduction of the correlation between achievement test performance and perceived anxiety. There is no reason to suspect that SAQ validity coefficients should always be of the same magnitude since the actual relationship between anxiety and achievement can change with changing conditions in the school.

The simplest explanation for the lack of difference between raw and adjusted validity coefficients for the 3rd grade is that response bias may not operate to the same extent or with the same degree of consistency across subjects in the early grades as in later grades. For example, acquiescence set, which is known to be prevalent in children (Christin & Lindauer, 1963) may be more consistent in its effects across children in the early grades than in later grades. If this were the case, providing the set did not completely obscure individual differences, acquiescence would have only a minimal effect on validity.

If response bias were operating less in the 3rd grade group than in others, high correlations would be expected between raw and adjusted scores for the various subscales. Table indicates that the correlations are quite high ranging from .67 to .84. However, similar correlations for other grade levels in many instances are also high.

Underlying the questions raised by the data is the issue of determining what conditions affect the ability of the RBAS procedure to increase validity. Results suggest that the procedure does produce validity coefficients of sufficient magnitude to be useful. But the studies which have been done to date have not been concerned with revealing the factors which may influence the effectiveness of the procedure.

A number of possible pertinent factors, each of which could provide a focus for future research, can be listed. For example, a response set operating on some, but not all, the items in a subscale might affect validity. The correlations of a response set with a particular subscale might influence the validity of that subscale. Finally, the characteristics of the RBAS, e.g. the mean, standard deviation, item intercorrelations, and reliability, could exert significant influence on the effectiveness of the RBAS procedure.

Future efforts designed to investigate potential influences on the RBAS procedure include a series of data simulation studies in which various types and levels of response bias will be simulated and their effects on the ability of the scoring procedure to produce accurate validity coefficients assessed.

These studies will provide both a measure of the robustness of the scoring procedure and point out conditions which may influence its efficiency.

APPENDIX A

TEST INSTRUCTIONS

SPEED OF INFORMATION PROCESSING TEST

Semantic Content

"We are going to run some films to learn from you how children recognize things. No one is expected to get all the answers right. Just try to get as much right as you can. Please pay close attention.

Now I am going to show you a film that has on it some words. The first thing you will see is a black dot that shows where the word will be on the screen. Look closely at the place where you see the dot, because the first word will appear there for just a short time and then a second nonsense word will come on. After the nonsense word has gone off the screen, draw a ring around the word on your list that is the same as the FIRST word that you saw. After you do that, another dot, followed by a new word, will come on the screen. Do the same thing as you did with the first word.

Let's try some examples. (Use of example sheets) Suppose that this word ('but') appeared on the screen. You would look for it among the five words in the first example. Now draw a ring around the correct word. Let's try another. Suppose that this word, ('is'), appeared on the screen. Draw a ring around the correct word.

Part way through the film you will see two words flashed on the screen at the same time and you are to draw a ring around each of them, one in each column, like this. Now you do the examples.

[1]A little further through the film you will see three words flashed on the screen at the same time and you are to draw rings around each of these, one in each column. Now you do it. Here's another one. Draw rings around the correct answers.

Now I will show you the film. Remember, no one is expected to get all of the answers right. Draw a ring around the FIRST word that appears after the dot." (During the first two trials the examiner should say, "Dot No. ___", "Turn the page" (whenever pertinent), and (whenever pertinent), "Now you will see two words at the same time....Now you will see three words at the same time".

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[1] Instructions for 3 stimuli in all subtests were used only with the 5th grade sample.

Figural Content

"Now I am going to show you a film that has on it some shapes which will appear after the black dot. You are to draw a ring around the shape on your answer sheet that is the same as the FIRST shape that you saw.

Let's try some examples. Suppose that this shape (point to a triangle on the answer sheet) appeared on the screen. You would look for it among the two shapes in the first example. Now draw a ring around the correct shape. Let's do the next example now.

Part way through the film you will see two shapes flashed on the screen at the same time, and you are to draw a ring around each of them, one in each column. Now you do the examples.

A little further through the film you will see three shapes flashed on the screen at the same time and you are to draw rings around each of them, one in each column. Now you do the examples.

Now I will show you the film. Draw a ring around the FIRST shape that appears after the dot. (During the first two trials, the examiner should say, "Dot No. ___ (when the dot appears), draw a ring around the FIRST shape you saw." For the remaining trials, say, "Dot No. ___", "Turn the page (whenever pertinent)", "Now you will see two shapes at the same time.....Now you will see three shapes at the same time."

Symbolic Content

"Now I am going to show you a film that has on it some numerals which will appear after the black dot. The first numeral will appear there for just a short time and then a second numeral will appear. You are to draw a ring around the numeral on your answer sheet that is the same as the FIRST numeral that you saw on the screen after the dot.

Let's try some examples. Suppose that this numeral (2) appeared on the screen. You would look for it among the five numerals in the first example. Now you draw a ring around the correct numeral. You do the next example now.

Part way through the film you will see two numerals flashed on the screen at the same time, followed by two more. You are to draw a ring around the FIRST two numerals you saw, one in each column on your answer sheet. Now do the examples.

A little further through the film you will see three numerals flashed on the screen at the same time and you are to draw rings around each of them, one in each column. Now you do the examples.

Now I will show you the film. Draw a ring around the FIRST numeral that appears after the dot. (During the first two trials, the examiner should say, "Dot No. ___ (when the dot appears), draw a ring around the FIRST numeral you saw." For the remaining trials, say, "Dot", "Turn the page (whenever pertinent)", "Now you will see two numerals at the same time.....Now you will see three numerals at the same time".

Behavioral Content

"Now I am going to show you a film that has on it some faces which will appear after the black dot. You are to draw a ring around the face on your answer sheet that is the same as the FIRST face that you saw.

Let's try some examples. Suppose that this face with a mouth appeared on the screen. You would look for it among the two faces in the first example. Now you draw a ring around the correct face. Let's do the next example.

Part way through the film you will see a face with mouth and eyes flashed on the screen and you are to draw a ring around the face on your answer sheet which is like it. Now you do the examples.

A little further through the film you will see a face with mouth, eyes and eyebrows flashed on the screen and you are to draw rings around the face like it on the answer sheet. Now you do the examples.

Now I will show you the film. Draw a ring around the FIRST face that appears after the dot. (During the first two trials, the examiner should say, "Dot No. ___ (when the dot appears), draw a ring around the FIRST face you saw." For the remaining trials, say, "Dot No. ___", "Now you will see a face with a mouth and eyes.....Now you will see a face with a mouth, eyes, and eyebrows."

Position in Space

"Now I am going to show you a film that has on it some circles with lines inside which will appear after the black dot. You are to draw a ring around the circle on your answer sheet that is the same as the FIRST circle that you saw.

Let's try some examples. Suppose that this circle with a line appeared on the screen. You would look for it among the four circles with lines in the first example. Now you draw a ring around the correct circle. Let's do the next example.

Part way through the film you will see two circles flashed on the screen at the same time and you are to draw a ring around each of them, one in each column. Now you do the examples.

A little further through the film you will see three circles flashed on the screen at the same time and you are to draw rings around each of them, one in each column. Now you do the examples.

Now I will show you the film. Draw a ring around the FIRST circle that appears after the dot. (During the first two trials, the examiner should say, "Dot No. ___ (when the dot appears), draw a ring around the FIRST circle you saw." For the remaining trials, say, "Dot No. ___", "Turn the page (whenever pertinent)", "Now you will see two circles at the same time.....Now you will see three circles at the same time."

APPENDIX B

EXAMPLES OF RESPONSE FORMS FOR SPEED OF INFORMATION PROCESSING TESTS

NAME:____

DATE:____

GRADE:_______________________________________

TEACHER:_____________________________________

SCHOOL:______________________________________

SEX: BOY GIRL

BIRTHDATE:___________________________________

DRAW A CIRCLE AROUND THE CORRECT ANSWER

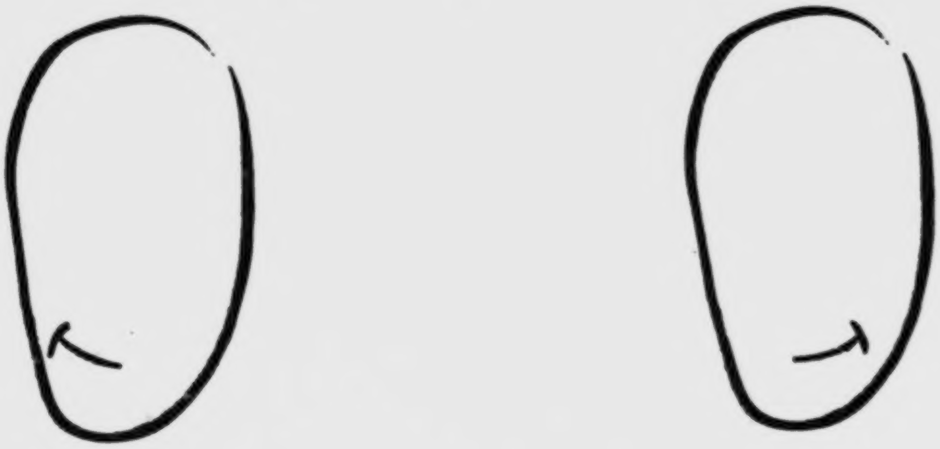
____

____

____

1

2



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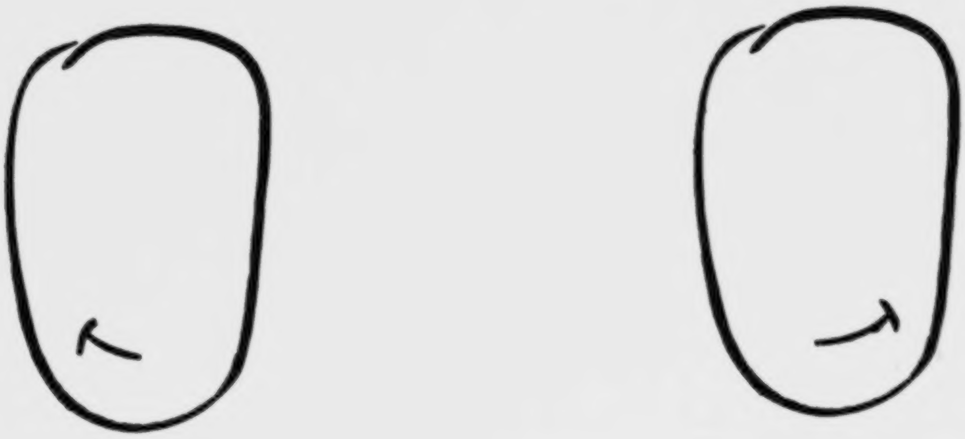

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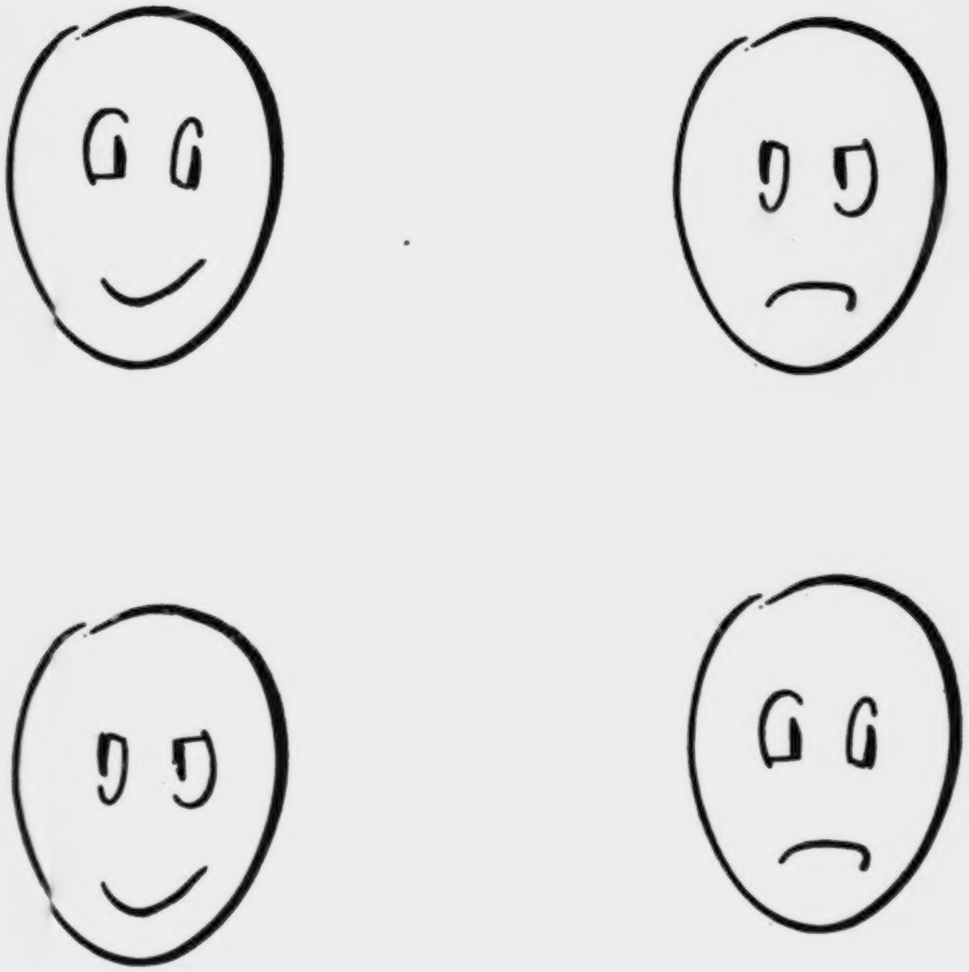

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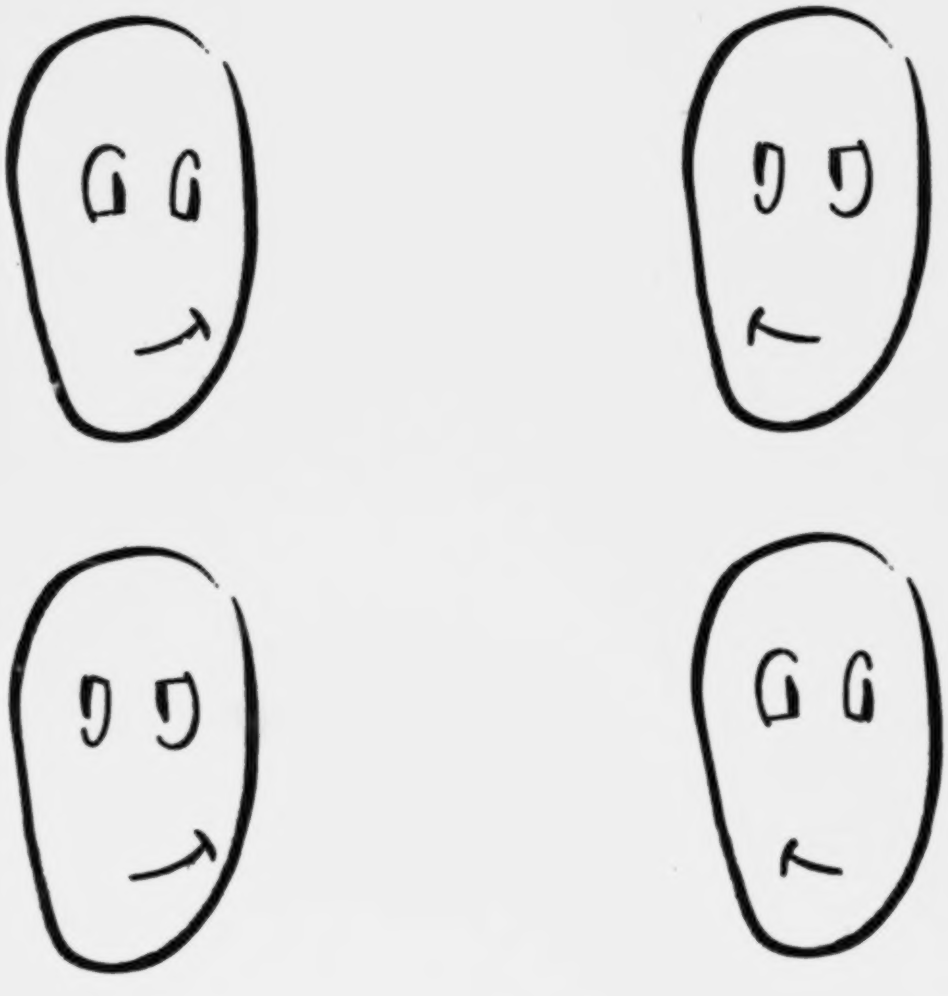

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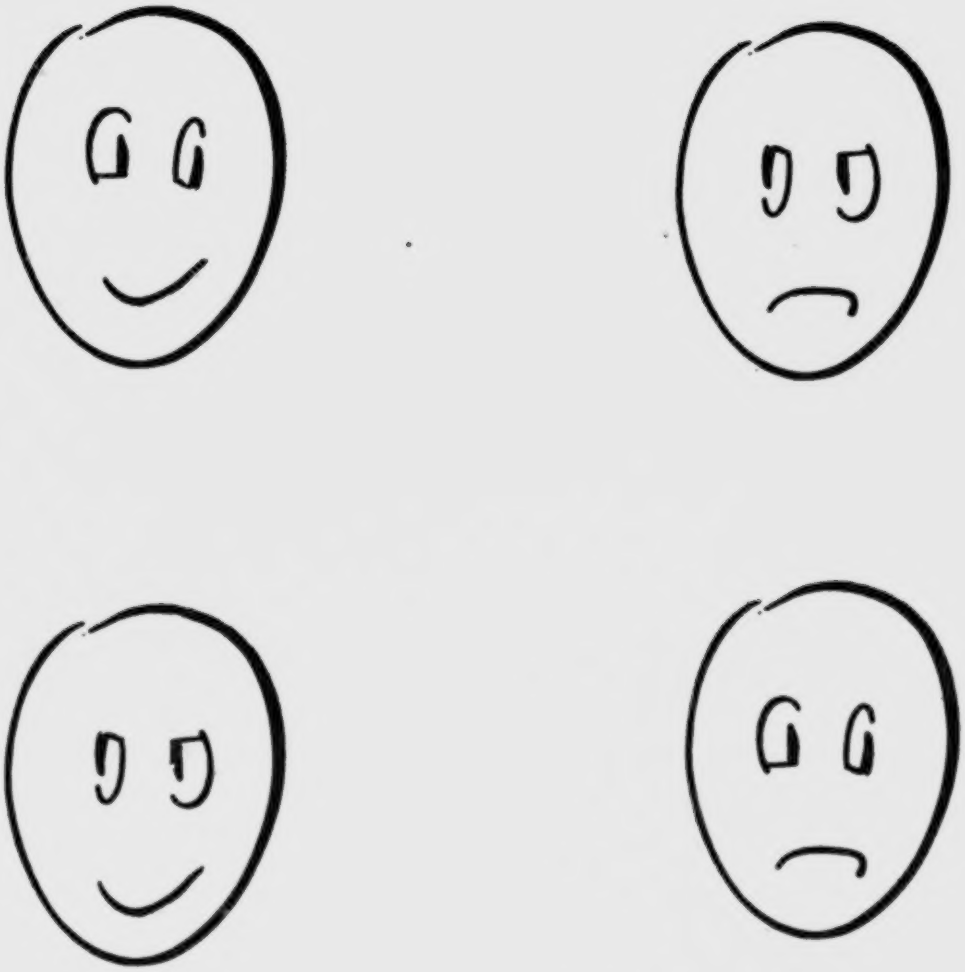

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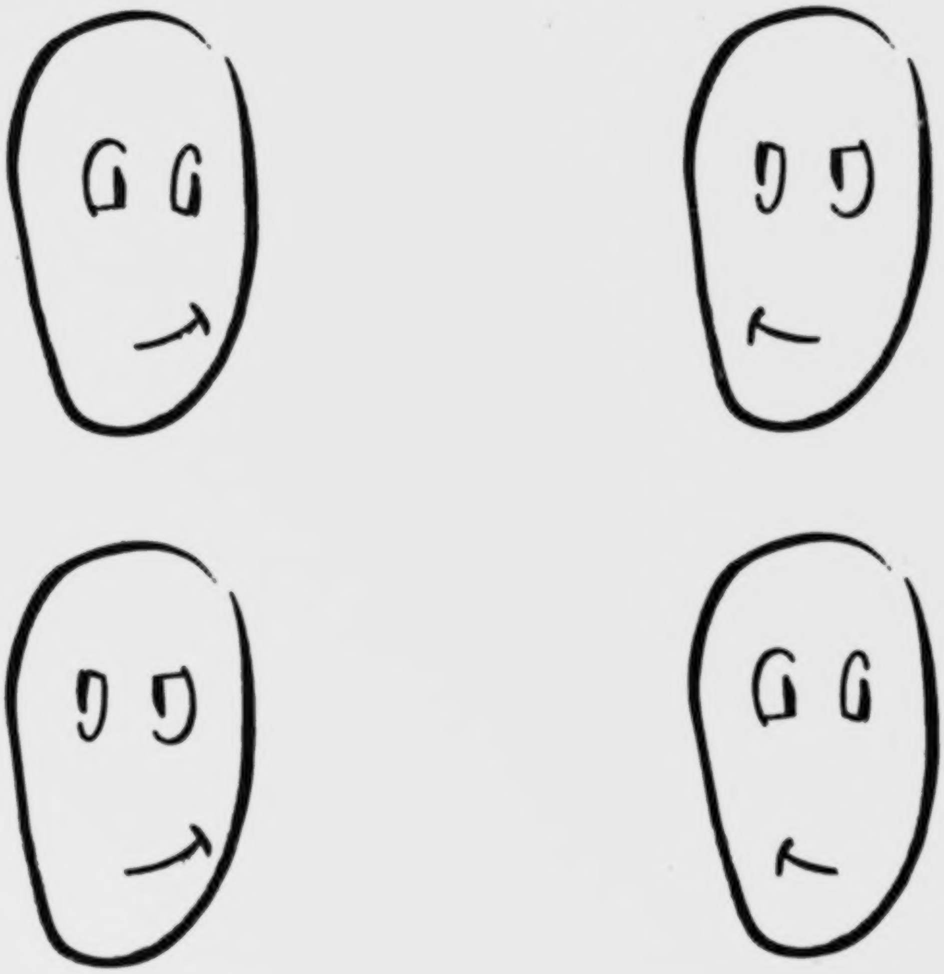

5

1.	the end term hard large
2.	are sat wet saw nod
3.	and ask cut eat use
4.	yes hat bed try get
5.	yet who bat web was

1.	big	cow
	nice	dish
	last	car
	that	boy
	his	dog
2.	get	here
	kick	now
	say	over
	grow	this
	was	there
3.	new	work
	old	shoe
	our	man
	his	eyes
	good	book
4.	our	chicks
	dry	cat
	ten	men
	what	desks
	two	toys
5.	be	there
	did	even
	get	so
	go	far
	was	dry

1.	my	tiny	dish
	your	fat	hat
	that	blue	girl
	dad's	new	drum
	the	good	field
2.	five	are	back
	we	ran	here
	they	went	out
	pigs	came	away
	all	look	down
3.	on	the	pole
	in	his	car
	to	a	barn
	find	your	tent
	saw	my	train
4.	it	is	in
	boy	goes	across
	he	moves	for
	father	plays	into
	baby	came	with
5.	make	four	boats
	put	red	drums
	see	new	cards
	buy	five	shoes
	send	many	rings

1.	4 7 1 9 3
2.	2 9 4 3 5
3.	1 3 9 4 7
4.	2 4 1 7 3
5.	5 8 6 3 2

1.	3	1
	5	6
	9	5
	6	4
	7	1
2.	8	4
	2	9
	9	1
	6	1
	3	2
3.	4	1
	6	9
	3	7
	1	2
	5	6
4.	8	9
	6	7
	3	8
	2	1
	4	8
5.	5	6
	8	5
	3	2
	6	9
	1	4

1.	4	2	3
	7	5	3
	3	9	1
	5	6	7
	8	1	5
2.	3	8	8
	2	9	6
	3	6	5
	2	1	3
	5	4	2
3.	1	2	9
	6	4	1
	7	9	2
	2	5	7
	6	3	4
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	9	5	7
	6	7	3
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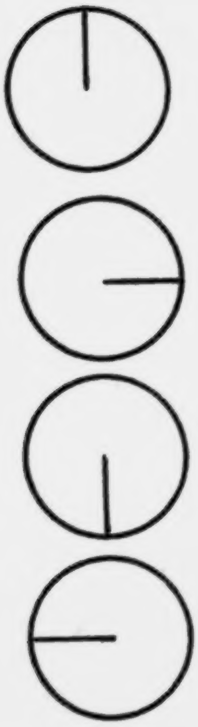
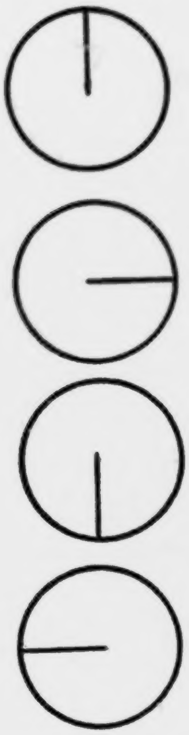
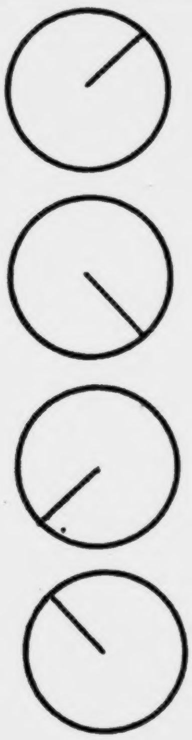
	9	8	5
	6	3	8







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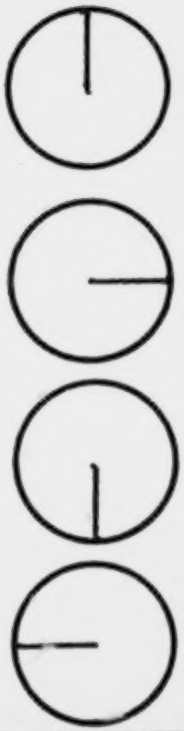

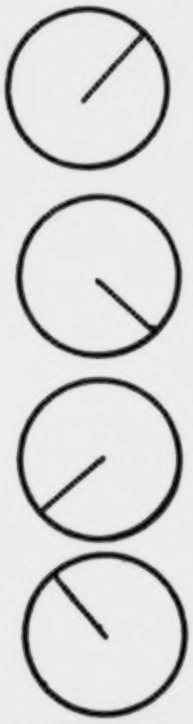

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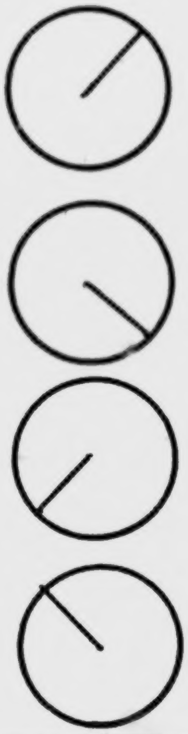

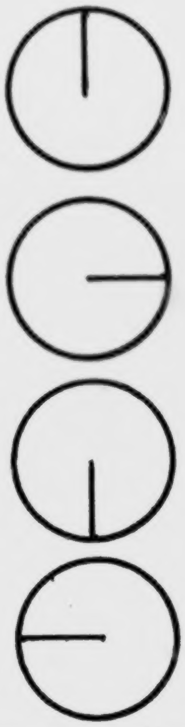

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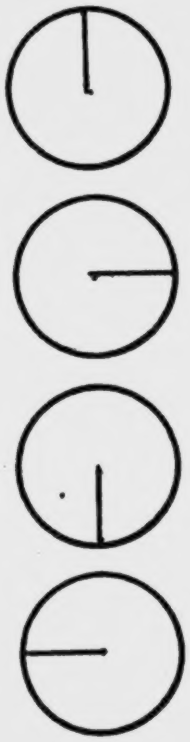

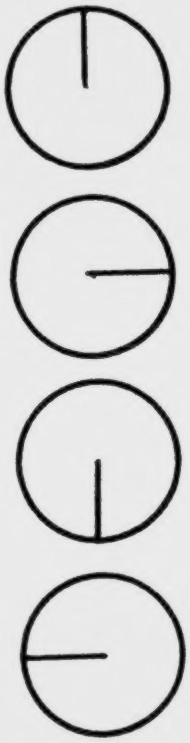

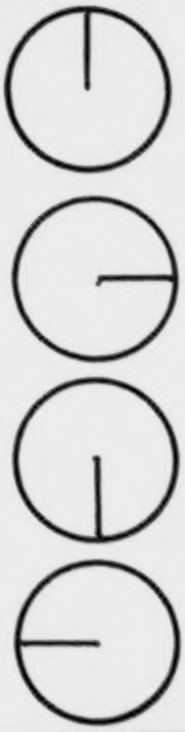
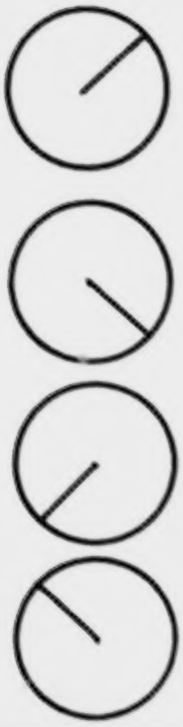

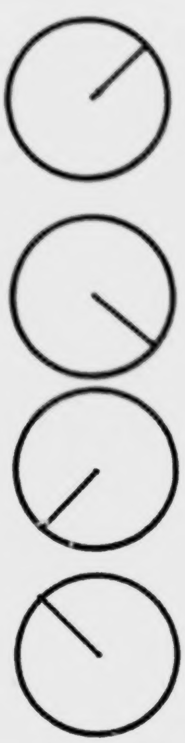

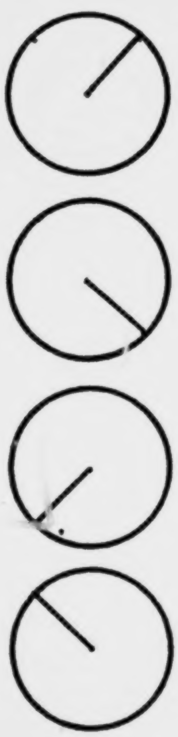
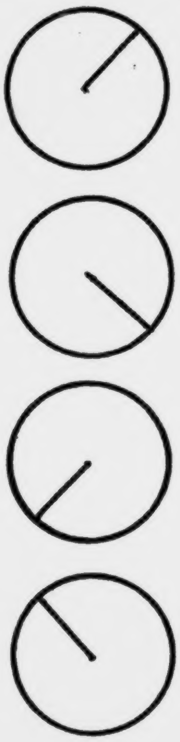
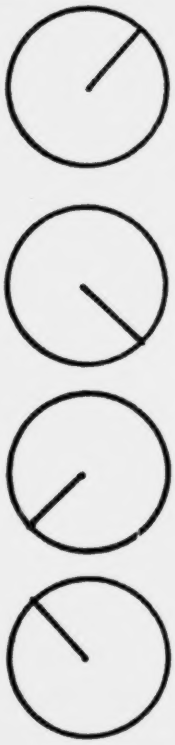

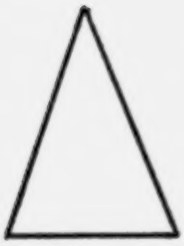

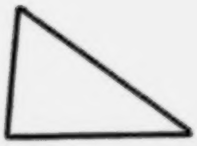

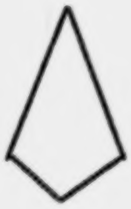

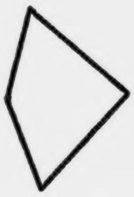

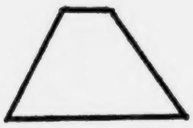

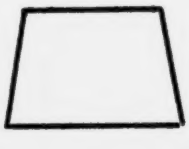

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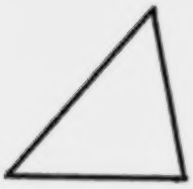

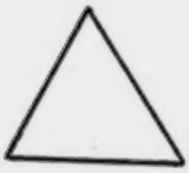

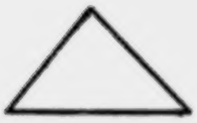

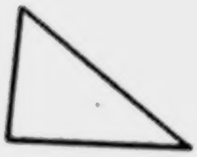

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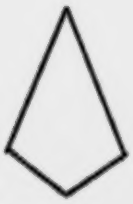

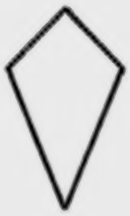

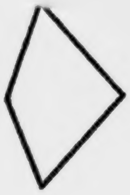

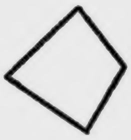

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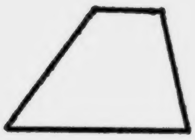

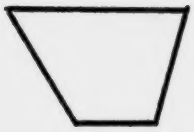

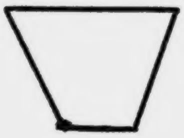

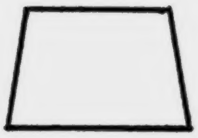

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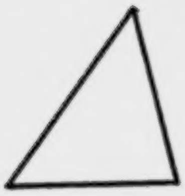
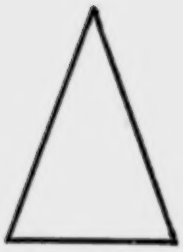
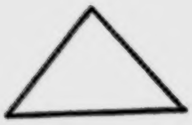
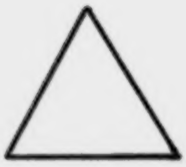
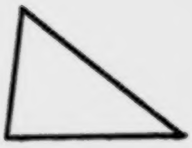
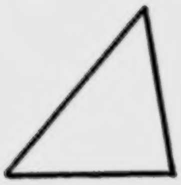

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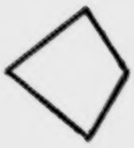
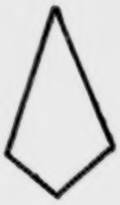
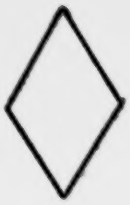
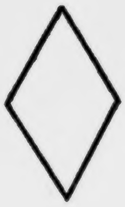
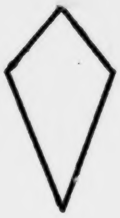
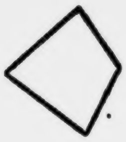

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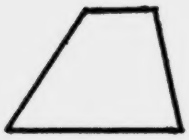
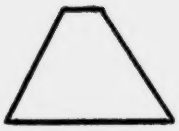
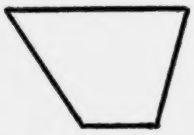
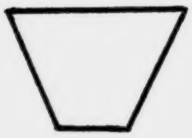
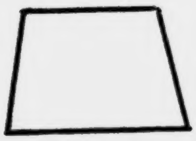
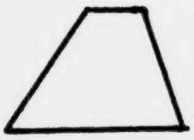

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